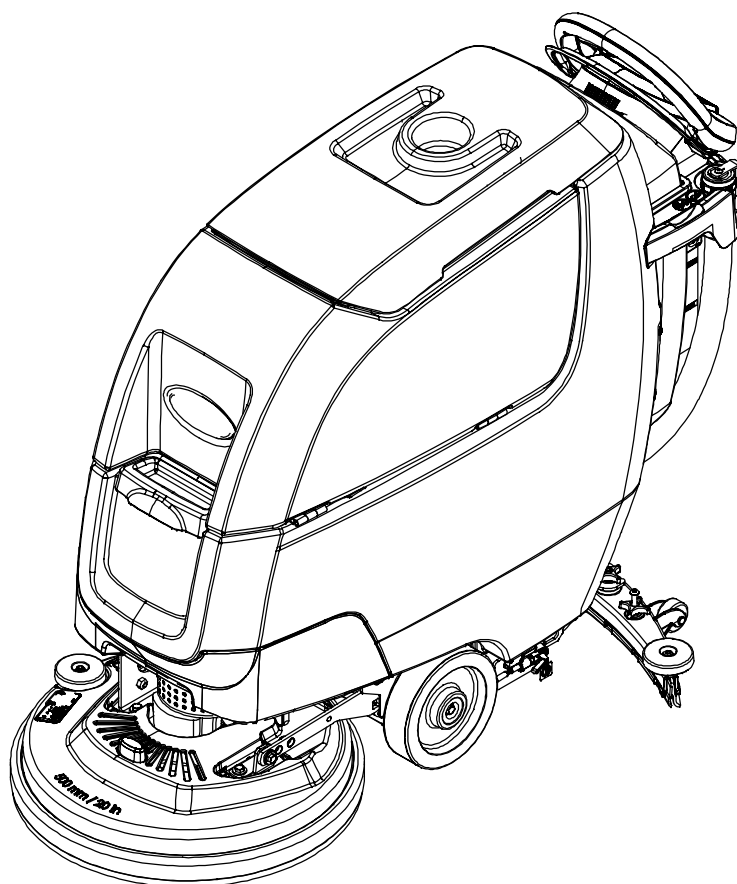




SPEED SCRUB® 300

Automatic Floor Scrubber

Service Information Manual



For the latest Parts Manuals and other
language Operator Manuals, visit:

www.tennantco.com/manuals

9014516
Rev. 01 (3-2017)



INTRODUCTION

This manual is available for each new model. It provides necessary operation and maintenance instructions.



Read this manual completely and understand the machine before operating or servicing it.

This machine will provide excellent service. However, the best results will be obtained at minimum costs if:

- The machine is operated with reasonable care.
- The machine is maintained regularly - per the machine maintenance instructions provided.
- The machine is maintained with manufacturer supplied or equivalent parts.



PROTECT THE ENVIRONMENT

Please dispose of packaging materials and used machine components such as batteries in an environmentally safe way according to your local waste disposal regulations.



Always remember to recycle.

Tennant Company

PO Box 1452
Minneapolis, MN 55440
Phone: (800) 553- 8033 or (763) 513- 2850
www.tennantco.com

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This product may contain portions of software that have various 3rd party licenses. More information can be found at: www.tennantco.com/opensource

Specifications and parts are subject to change without notice.

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INTENDED USE

The automatic floor scrubber is intended for commercial use, for example in hotels, schools, hospitals, factories, shops, offices and rental businesses. It is designed to scrub hard floor surfaces (concrete, tile, stone, synthetic, etc.) in an indoor environment. Do not use this machine on carpeted surfaces. Use only recommended pads/brushes and commercially available floor cleaning detergents. Do not use this machine other than described in this Operator Manual.

MACHINE DATA

Please fill out at time of installation for future reference.

Model No. - _____

Serial No. - _____

Installation Date - _____

SERIAL NUMBER LOCATION



UNCRATING MACHINE

Carefully check machine for signs of damage. Report damages at once to carrier. Contact distributor or Tennant for missing items.

To uncrate the machine, remove straps, wheel blocks and shipping brackets. Using the supplied ramp carefully back the machine off the pallet. Make sure scrub head is in the raised position.

ATTENTION: Do not remove machine from pallet without using ramp, machine damage may occur.

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SAFETY PRECAUTIONS

IMPORTANT SAFETY INSTRUCTIONS - SAVE THESE INSTRUCTIONS

The following warning precautions are used throughout this manual as indicated in their description:

⚠ WARNING: To warn of hazards or unsafe practices which could result in severe personal injury or death.

FOR SAFETY: To identify actions which must be followed for safe operation of equipment.

The following information signals potentially dangerous conditions to the operator. Know when these conditions can exist. Locate all safety devices on the machine. Report machine damage or faulty operation immediately.

⚠ WARNING: To Reduce the Risk of Fire, Explosion, Electric Shock or Injury:

- Read manual before operating machine.
 - Do not use or pick up flammable materials.
 - Do not use near flammable liquids, vapors or combustible dusts.
- This machine is not equipped with an explosion proof motor. The electric motor will spark upon start up and during operation which could cause a flash fire or explosion if machine is used in an area where flammable vapors/liquids or combustible dusts are present.
- Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away when charging.
 - Disconnect battery cables and charger cord before cleaning and servicing machine.
 - Do not charge batteries with damaged cord. Do not modify plug.

If the charger supply cord is damaged or broken, it must be replaced by the manufacturer or its service agent or a similarly qualified person in order to avoid a hazard.

- Do not use outdoors. Store indoors.
- Spinning pad/brush, keep hands away.

⚠ WARNING: Magnetic Field Hazard. Magnetic pad driver/brush can be harmful to pacemaker wearers or medical implants.

This machine may be equipped with technology that automatically communicates over the cellular network. If the machine will be operated where cell phone use is restricted because of concerns related to equipment interference, please contact a Tennant representative for information on how to disable the cellular communication functionality.

FOR SAFETY:

1. Do not operate machine:
 - Unless trained and authorized.
 - Unless operator manual is read and understood.
 - Unless mentally and physically capable of following machine instructions.
 - Under the influence of alcohol or drugs.
 - While using a cell phone or other types of electronic devices.
 - If not in proper operating condition.
 - In outdoor areas. This machine is for indoor use only.
 - In areas where flammable vapors/liquids or combustible dusts are present.
 - With pads or accessories not supplied or approved by Tennant. The use of other pads may impair safety.
 - In areas with possible falling objects.
 - In areas that are too dark to safely see the controls or operate machine.
2. Before operating machine:
 - Check machine for fluid leaks.
 - Make sure all safety devices are in place and operate properly.
3. When operating machine:
 - Use only as described in this manual.
 - Report machine damage or faulty operation immediately.
 - Wear closed-toe, non-slip work shoes.
 - Reduce speed when turning.
 - Go slowly on inclines and slippery surfaces.
 - Do not scrub on inclines that exceed 9% grade or transport on inclines that exceed 21% grade.
 - Follow site safety guidelines concerning wet floors.
 - Follow mixing, handling and disposal instructions on chemical containers.
 - Do not carry passengers on machine.
 - Use care when reversing machine.
 - Keep children and unauthorized persons away from machine.
 - Do not allow machine to be used as a toy.

SAFETY PRECAUTIONS

4. Before leaving or servicing machine:
 - Stop on level surface.
 - Set the parking brake, if equipped.
 - Turn off machine and remove key.
5. When servicing machine:
 - Disconnect battery connection and charger cord before working on machine.
 - All work must be done with sufficient lighting and visibility.
 - All repairs must be performed by trained personnel.
 - Use Tennant supplied or approved replacement parts.
 - Do not modify the machine from its original design.
 - Do not jack up machine.
 - Avoid moving parts. Do not wear loose clothing or jewelry and secure long hair.
 - Do not disconnect the off-board charger's DC cord from the machine's receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging cycle, disconnect the AC power supply cord first.
 - Do not use incompatible battery chargers as this may damage battery packs and potentially cause a fire hazard.
 - Inspect charger cord regularly for damage.
 - Keep work area well ventilated.
 - Avoid contact with battery acid.
 - Keep all metal objects off batteries.
 - Do not power spray or hose off machine.
 - Use a hoist or adequate assistance when lifting batteries.
 - Battery installation must be done by trained personnel.
 - Wear personal protection equipment as needed and where recommended in this manual.
6. When loading/unloading machine onto/off truck or trailer:
 - Drain tanks before loading machine.
 - Use a ramp, truck or trailer that can support the machine weight and operator.
 - Do not operate the machine on a ramp incline that exceeds a 21% grade level.
 - Use a winch if ramp incline exceeds a 21% grade level.
 - Lower the scrub head and squeegee before tying down machine.
 - Turn machine off and remove key.
 - Set parking brake (if equipped).
 - Block machine wheels.
 - Use tie-down straps to secure machine.



For Safety: wear protective gloves.



For Safety: wear eye protection.

SAFETY LABELS

The safety labels appear on the machine in the locations indicated. Replace labels if they are missing or become damaged or illegible.

WARNING LABEL - Located on recovery tank cover.



FOR SAFETY LABEL
Do not power spray (hose off machine.
Electrical malfunction may occur.

Located on control cor



WARNING LABEL -
Spinning pad. Keep hands away.
Located on disk scrub head model.



WARNING LABEL -
Spinning brush. Keep hands away.
Located on cylindrical scrub head model.



WARNING LABEL -
Magnetic Field Hazard. Magnetic pad driver/brush can be harmful to pacemaker wearers or medical implants.

Located on Insta-Click magnetic pad driver/brush.



WARNING LABEL -
Electrical hazard. Disconnect battery cables before servicing machine.

Located on circuit breaker panel.



WARNING LABEL -
Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away when charging.

Located on bottom side of recovery tank.

SAFETY PRECAUTIONS



WARNING LABEL -
Flammable materials or reactive metals can cause an explosion or fire. Do not pick up.

Located near control console.



FOR SAFETY LABEL - Read manual before operating machine.

Located near control console.



FOR SAFETY LABEL - Do not power spray or hose off machine. Electrical malfunction may occur.

Located on control console



WARNING LABEL -
Flammable materials can cause explosion or fire. Do not use flammable materials in tank(s).

Located on backside of solution tank cover.



WARNING LABEL -
Batteries emit hydrogen gas. Explosion or fire can result. Keep sparks and open flame away when charging.

Located on control console and bottom side of recovery tank.



WARNING LABEL -
Spinning pad. Keep hands away.

Located on disk scrub head model.



WARNING LABEL -
Do not charge batteries with damaged cord. Electric shock can result. Disconnect charger cord before servicing.

Located on control console.



WARNING LABEL -
Spinning brush. Keep hands away.

Located on cylindrical scrub head model.



WARNING LABEL -
Magnetic field hazard. Magnetic pad driver/brush can be harmful to pacemaker wearers or medical implants.

Located on Insta-Click magnetic pad driver/brush.



WARNING LABEL - Electrical Hazard. Disconnect battery cables before servicing machine.

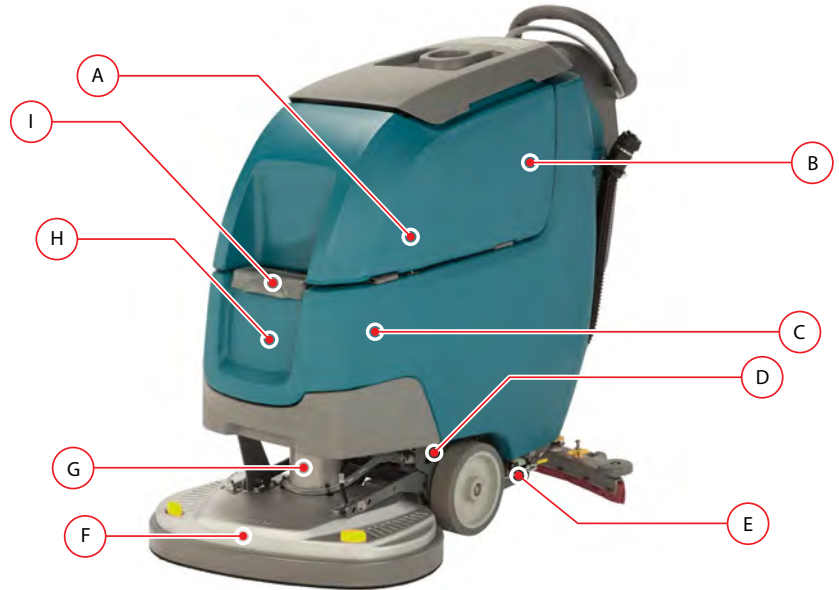
Located on circuit board panel.

GENERAL INFORMATION

Component Locator

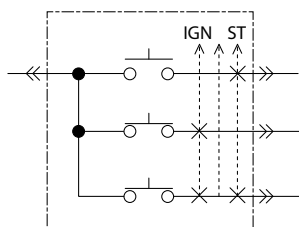
Components	
A	Batteries
B	Circuit Breakers and Optional Machine Control Module
C	ec-H2O System Components
D	Scrub Head Lift Contact Switch
E	Parking Brake Switch
F	Scrub Head Drive Belt
G	Scrub Motor (Disk Shown)
H	SE (Severe Environment) System Components
I	Solution Tank Fill Port
J	Onboard Battery Charger*
K	Interface Module w/ mini-USB Programming Port
L	Internal Bail Switch
M	Forward/ Reverse Propel Switch*
N	Scrub Head Linkage (Configurable)
O	Transaxle Assembly*
P	Rear Squeegee Lift Contact Switch
Q	I-Drive Propel Control Module*

* Optional Equipment

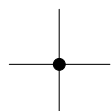


GENERAL INFORMATION

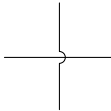
ELECTRICAL SCHEMATIC SYMBOLS



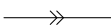
Key Switch



Connected



Not Connected



Connector



Energized



Adaptor Harness



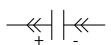
Notes



Assembly



AC Plug



Capacitor



Battery



Circuit Breaker



Fuse



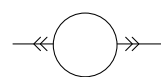
Diode



Single Continuation Tab



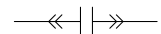
Double Continuation Tab



Relay Coil



N.C. Relay Contacts



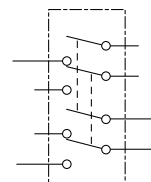
N.O. Relay Contacts



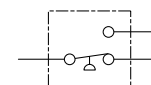
Horn or Alarm



Light



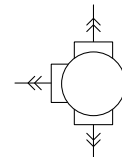
DPDT Switch



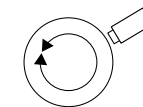
Pressure Switch



Motor



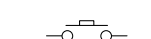
3 Phase AC Induction Motor



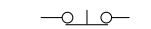
Motor Encoder



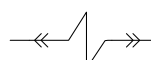
Sensor
(Variable Resistor)



Momenary Switch N.O.



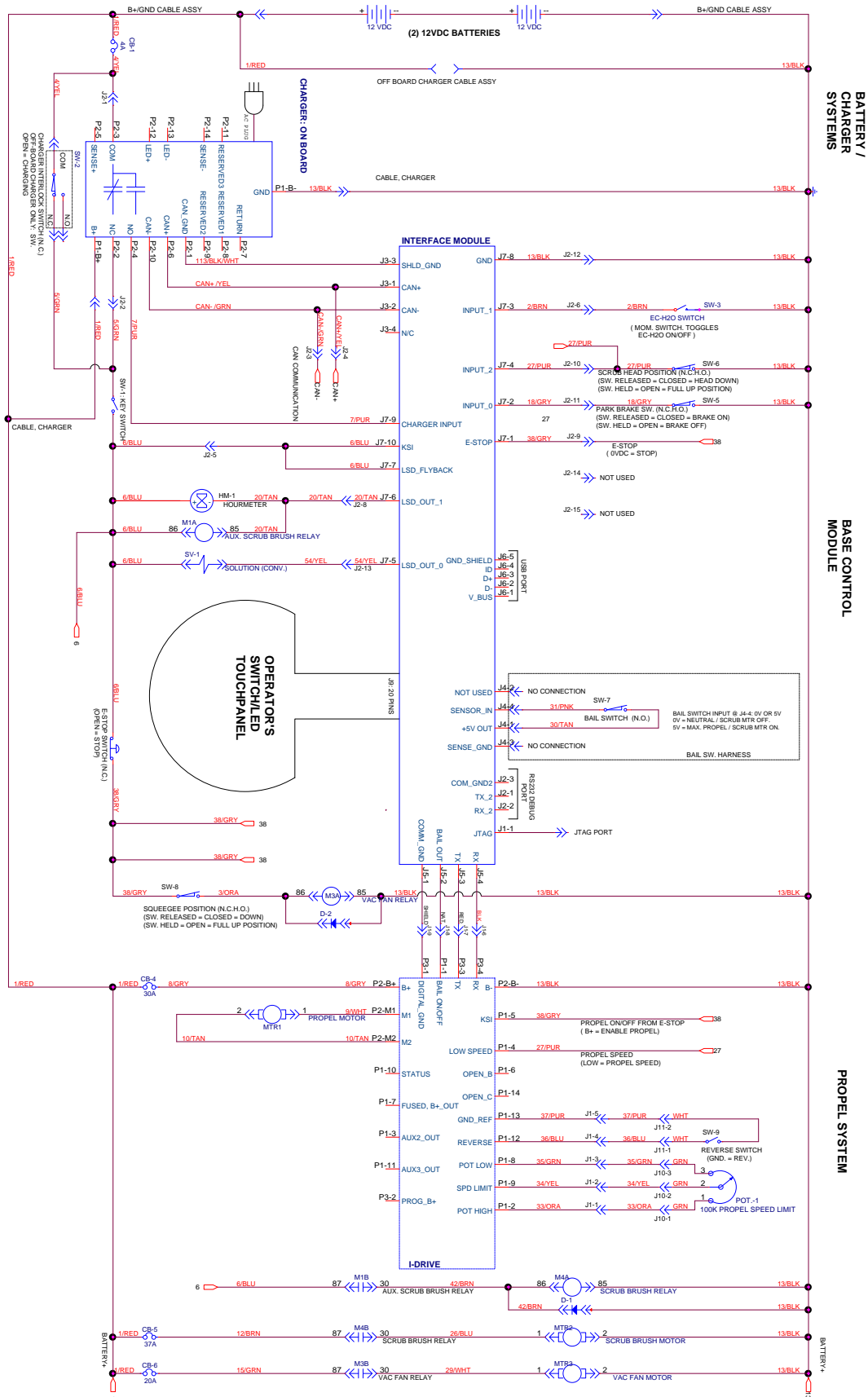
Contact Switch N.C.



Solenoid Valve

GENERAL INFORMATION

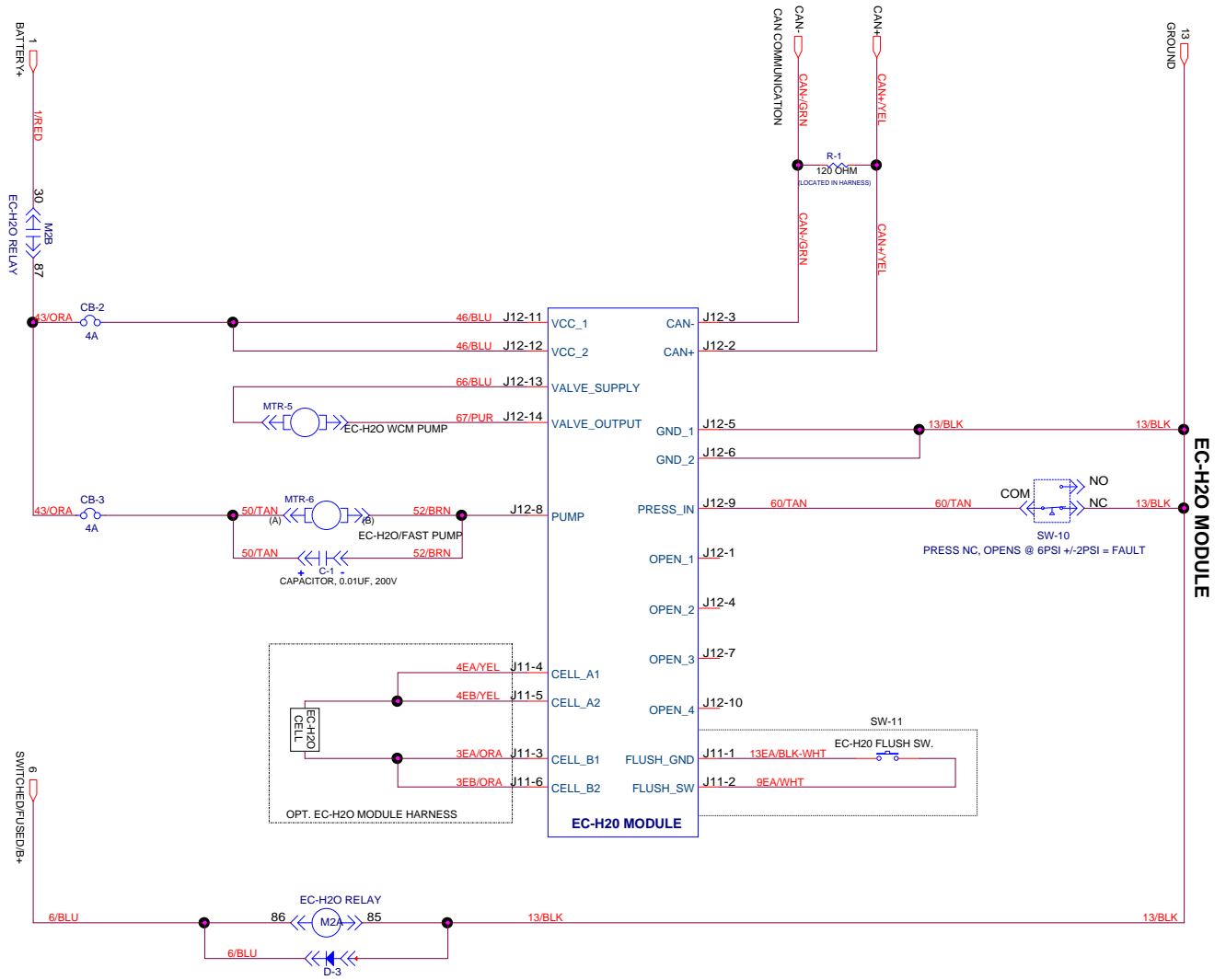
ELECTRICAL SCHEMATIC (DRIVE MODEL) - 1 of 2



ELECTRICAL SCHEMATIC (PUSH MODEL) - 1 of 2



ELECTRICAL SCHEMATIC (PUSH MODEL) - 2 of 2



GENERAL INFORMATION

OPERATIONAL MATRIX

FUNCTION	ENABLED	DISABLED
Vacuum Fan	<ul style="list-style-type: none"> • Squeegee Lowered 	<ul style="list-style-type: none"> • Squeegee Raised • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Main Scrub Motor	<ul style="list-style-type: none"> • Head Lowered - Foot Pedal • Fwd/Rev Throttle Command or Bail activated on non-propel models. 	<ul style="list-style-type: none"> • Head Raised - Foot Pedal • Neutral - Ready State or bail released on non-propel models. • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Propel (drive option)	<ul style="list-style-type: none"> • Fwd/Rev Throttle Command • Fwd/Rev Switch Input 	<ul style="list-style-type: none"> • Neutral - Ready State • Propel Motor Controller Fault • Battery Charger ON Interlock
Solution Control (Conventional)	<ul style="list-style-type: none"> • Head Lowered - Foot Pedal • Solution Control ON • Fwd/Rev Throttle Command or Bail activated on non-propel models. 	<ul style="list-style-type: none"> • Head Raised - Foot Pedal • Solution Control OFF • Neutral - Ready State or bail released on non-propel models. • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • Fault • Battery Charger ON Interlock
Solution Control (ec-H2O NanoClean - option)	<ul style="list-style-type: none"> • Head Lowered - Foot Pedal • Solution Control ON • ecH2O Switch ON • Fwd/Rev Throttle Command or Bail activated on non-propel models. 	<ul style="list-style-type: none"> • Head Raised - Foot Pedal • Solution Control OFF • ecH2O Switch OFF • Neutral - Ready State or bail released on non-propel models. • Low Battery Voltage (Wet < 21.9 V, AGM < 22.7 V) • ecH2O System Fault • Battery Charger ON Interlock

GENERAL INFORMATION

FASTENER TORQUE

SAE (STANDARD)

Thread Size	SAE Grade 1	SAE Grade 2 Carriage Bolts	Thread Cutting Thread Rolling	SAE Grade 5 Socket & Stainless Steel	SAE Grade 8	Headless Socket Set Screws	Square Head Set Screws	
4 (.112)	(5) - (6.5)					(4) - (6)		Inch Pounds
5 (.125)	(6) - (8)					(9) - (11)		
6 (.138)	(7) - (9)		(20) - (24)			(9) - (11)		
8 (.164)	(12) - (16)		(40) - (47)			(17) - (23)		
10 (.190)	(20) - (26)		(50) - (60)			(31) - (41)		
1/4 (.250)	4 - 5	5 - 6	7 - 10	7 - 10	10 - 13	6 - 8	17 - 19	Foot Pounds
5/16 (.312)	7 - 9	9 - 12	15 - 20	15 - 20	20 - 26	13 - 15	32 - 38	
3/8 (.375)	13 - 17	16 - 21		27 - 35	36 - 47	22 - 26	65 - 75	
7/16 (.438)	20 - 26	26 - 34		43 - 56	53 - 76	33 - 39	106 - 124	
1/2 (.500)	27 - 35	39 - 51		65 - 85	89 - 116	48 - 56	162 - 188	
5/8 (.625)		80 - 104		130 - 170	171 - 265		228 - 383	
3/4 (.750)		129 - 168		215 - 280	313 - 407		592 - 688	
1 (1.000)		258 - 335		500 - 650	757 - 984		1281 - 1489	

METRIC

Thread Size	4.8/5.6	8.8 Stainless Steel	10.9	12.9	Set Screws
M3	43 - 56 Ncm	99 - 128 Ncm	139 - 180 Ncm	166 - 215 Ncm	61 - 79 Ncm
M4	99 - 128 Ncm	223 - 290 Ncm	316 - 410 Ncm	381 - 495 Ncm	219 - 285 Ncm
M5	193 - 250 Ncm	443 - 575 Ncm	624 - 810 Ncm	747 - 970 Ncm	427 - 554 Ncm
M6	3.3 - 4.3 Nm	7.6 - 9.9 Nm	10.8 - 14 Nm	12.7 - 16.5 Nm	7.5 - 9.8 Nm
M8	8.1 - 10.5 Nm	18.5 - 24 Nm	26.2 - 34 Nm	31 - 40 Nm	18.3 - 23.7 Nm
M10	16 - 21 Nm	37 - 48 Nm	52 - 67 Nm	63 - 81 Nm	
M12	28 - 36 Nm	64 - 83 Nm	90 - 117 Nm	108 - 140 Nm	
M14	45 - 58 Nm	102 - 132 Nm	142 - 185 Nm	169 - 220 Nm	
M16	68 - 88 Nm	154 - 200 Nm	219 - 285 Nm	262 - 340 Nm	
M20	132 - 171 Nm	300 - 390 Nm	424 - 550 Nm	508 - 660 Nm	
M22	177 - 230 Nm	409 - 530 Nm	574 - 745 Nm	686 - 890 Nm	
M24	227 - 295 Nm	520 - 675 Nm	732 - 950 Nm	879 - 1140 Nm	

GENERAL INFORMATION

GENERAL MACHINE DIMENSIONS/CAPACITIES/PERFORMANCE

MODEL	17 in / 43 cm Disk (Push)	20 in / 50 cm Disk (Push)	17 in / 43 cm Disk (Drive)	20 in / 50 cm Disk (Drive)
Length	51.25 in / 1302 mm	54 in / 1372 mm	51.25 in / 1302 mm	54 in / 1372 mm
Width	21 in / 508 mm	22 in / 559 mm	21 in / 508 mm	22 in / 559 mm
Height	43.1 in / 1095 mm	43.1 in / 1095 mm	43.1 in / 1095 mm	43.1 in / 1095 mm
Weight	220 lb / 98 kg	230 lb / 104 kg	230 lb / 104 kg	240 lb / 109 kg
Weight (with batteries)	366 lb / 166 kg	376 lb / 171 kg	390 lb / 177 kg	400 lb / 181 kg
GVW	457 lb / 207 kg	467 lb / 212 kg	482 lb / 219 kg	492 lb / 223 kg
Squeegee width	30.4 in / 772 mm			
Recovery tank capacity	14 gal / 53 L			
Solution tank capacity	11 gal / 42 L			
Scrubbing path width	16.9 in / 430 mm	19.9 in/ 505 mm	16.9 in / 430 mm	19.9 in / 505 mm
Down pressure	47 lbs / 21.3 kg	52 lbs / 23.5 kg	47 lbs / 21.3 kg	51 lbs / 23 kg
Dual down pressure	88 lbs / 40 kg	92 lbs / 41.7 kg	86 lbs / 39 kg	90 lbs / 41 kg
Scrubbing speed	Pad assist		200 fpm / 61 mpm	
Transport speed	n/a	n/a	240 fpm / 73 mpm	
Reverse speed	n/a	n/a	144 fpm / 44 mpm	
Productivity rate - estimated actual	9,340ft2/hr / 868m2/hr	11,208ft2/hr / 1041m2/hr	12,453ft2/hr / 1157m2/hr	14,943ft2/hr / 1,388m2/hr
ec-H2O productivity rate - est. actual	9,668ft2/hr / 898m2/hr	11,602ft2/hr / 1078m2/hr	12,891ft2/hr / 1198m2/hr	15,469ft2/hr / 1,437m2/hr
Aisle turnaround width	52 in / 1321 mm	54.5 in / 1384 mm	52 in / 1321 mm	54.5 in / 1384 mm
Ramp incline for scrubbing	9% maximum			
Ramp incline for transporting	21% maximum			
Ramp incline for loading - empty tanks	21% maximum			
Solution flow rate	Low: 0.15 gpm / 0.57 L/min, Med: 0.35 gpm / 1.3 L/min, High: 0.5 gpm / 1.9 L/min			
ec-H2O solution flow rate	Low: 0.12 gpm / 0.45 L/min, Med: 0.25 gpm / 0.94 L/min, High: 0.35 gpm / 1.3 L/min			
Brush motor	24 VDC, 1hp / 0.75kW			
Propel motor	n/a	n/a	24 VDC, 0.23 hp / 0.175 kW	
Vacuum motor	24 VDC, 0.6 hp / 0.47 kW			
Water lift	42 in / 1067 mm			
ec-H2O solution pump	24 VDC, 1.0 gpm / 3.8 L/min, min open flow			
Machine voltage	24 VDC			
Battery capacity	2 - 12 V 105AH C/20 Wet, 2-12V 130AH C/20 Wet, 2 - 12V 155AH C/20 Wet, 2 - 12V 140AH C/20 Sealed/AGM			
Total power consumption	31.5A nominal	36.5A nominal	34.5A nominal	39.5A nominal
Battery Charger - on-board	100-240VAC, 50/60Hz, 24 VDC, 13A			
Battery Charger - smart off-board	100-240VAC, 50/60Hz, 24 VDC, 13A			
Protection grade	IPX3			
Sound pressure level L _{pA} *	67 dB(A)	67 dB(A)	67 dB(A)	67 dB(A)
Sound uncertainty K _{pA} *	0.8 dB(A)	0.8 dB(A)	0.8 dB(A)	0.8 dB(A)
Sound power level uncertainty L _{wA} - uncertainty K _{wA} *	84.3 dB(A)	84.3 dB(A)	84.3 dB(A)	84.3 dB(A)
Machine vibration at hand-arm*	<2.5 m/s2			
Ambient operating temperature	Min: 32°F/0°C, Max: 110°F/43°C			

*Values per EN 60335-2-72. Specifications are subject to change without notice.

GENERAL INFORMATION

GENERAL MACHINE DIMENSIONS/CAPACITIES/PERFORMANCE

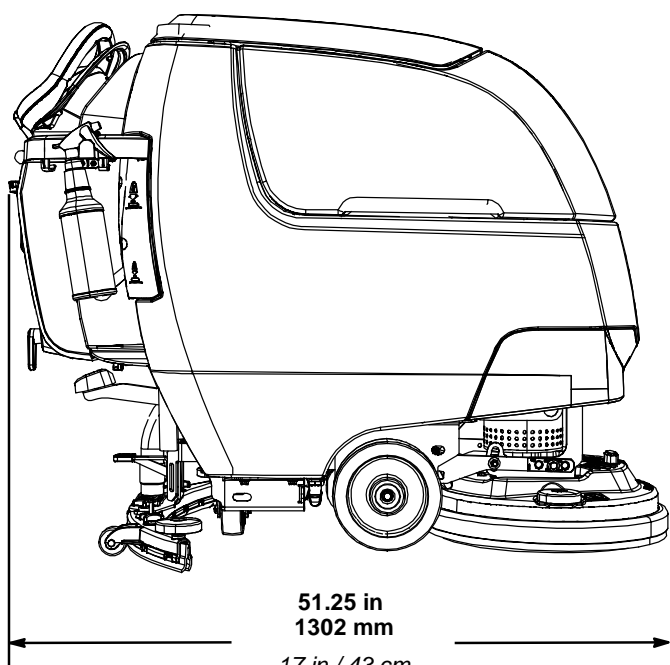
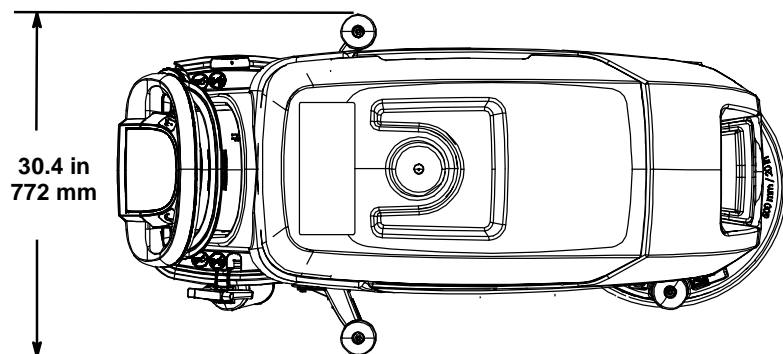
MODEL	24 in / 60 cm Dual Disk	20 in / 50 cm Cylindrical Brush	20 in / 50 cm Orbital
Length	51.75 in / 1314 mm	50.5 in / 1283 mm	49 in / 1245 mm
Width	26 in / 660 mm	25 in / 635 mm	20.5 in / 521 mm
Height	43.1 in / 1095 mm	43.1 in / 1095 mm	43.1 in / 1095 mm
Weight	250 lb / 113 kg	250 lb / 113 kg	255 lb / 216 kg
Weight (with batteries)	410 lb / 186 kg	410 lb / 186 kg	415 lb / 188 kg
GVW	502 lb / 228 kg	502 lb / 228 kg	507 lb / 230 kg
Squeegee width	30.4 in / 772 mm		
Recovery tank capacity	14 gal / 53 L		
Solution tank capacity	11 gal / 42 L		
Severe environment tank capacity	0.4 gal / 1.5 L		
Scrubbing path width	23.6 in / 600 mm	19.7 in / 500 mm	19.7 in / 500 mm
Down pressure	57 lbs / 26 kg	53 lbs / 24 kg	63 lbs / 28.5 kg
Dual down pressure	97 lbs / 44 kg	64 lbs / 29 kg	109 lbs / 49.5 kg
Scrubbing speed	200 fpm / 61 mpm		
Transport speed	240 fpm / 73 mpm		
Reverse speed	144 fpm / 44 mpm		
Productivity rate - estimated actual	18,264ft ² /hr / 1697m ² /hr	14,943ft ² /hr / 1388m ² /hr	14,943ft ² /hr / 1388m ² /hr
ec-H ₂ O productivity rate - est. actual	18,906ft ² /hr / 1756m ² /hr	15,469ft ² /hr / 1437m ² /hr	15,469ft ² /hr / 1437m ² /hr
Aisle turnaround width	53.5 in / 1346 mm	52 in / 1321 mm	49 in / 1245 mm
Ramp incline for scrubbing	9% maximum		
Ramp incline for transporting	21% maximum		
Ramp incline for loading - empty tanks	21% maximum		
Solution flow rate	Low: 0.15 gpm / 0.57 L/min, Med: 0.35 gpm / 1.3 L/min, High: 0.5 gpm / 1.9 L/min		
ec-H ₂ O solution flow rate	Low: 0.12 gpm / 0.45 L/min, Med: 0.25 gpm / 0.94 L/min, High: 0.35 gpm / 1.3 L/min		
Brush motor	24 VDC, 1hp / 0.75kW		
Propel motor	24 VDC, 0.23 hp / 0.175 kW		
Vacuum motor	24 VDC, 0.6 hp / 0.47 kW		
Water lift	42 in / 1067 mm		
Water lift - Quiet Mode	28 in / 711 mm		
ec-H ₂ O solution pump	24 VDC, 1.0 gpm / 3.8 L/min, min open flow		
Machine voltage	24 VDC		
Battery capacity	2 - 12 V 105AH C/20 Wet, 2-12V 130AH C/20 Wet, 2 - 12V 155AH C/20 Wet, 2 - 12V 140AH C/20 Sealed/AGM		
Total power consumption	36A nominal	40A nominal	30A nominal
Battery Charger - on-board	100-240VAC, 50/60Hz, 24 VDC, 13A		
Battery Charger - smart off-board	100-240VAC, 50/60Hz, 24 VDC, 13A		
Protection grade	IPX3		
Sound pressure level L _{pA} *	67.7 dB(A)	67 dB(A)	67.5 dB(A)
Sound uncertainty K _{pA} *	0.8 dB(A)	0.8 dB(A)	0.8 dB(A)
Sound power level uncertainty L _{WA} - uncertainty K _{WA} *	83.8 dB(A)	85 dB(A)	83.5 dB(A)
Machine vibration at hand-arm*	<2.5 m/s ²		
Ambient operating temperature	Min: 32°F/0°C, Max: 110°F/43°C		

*Values per EN 60335-2-72, Specifications are subject to change without notice.

GENERAL INFORMATION

MACHINE DIMENSIONS

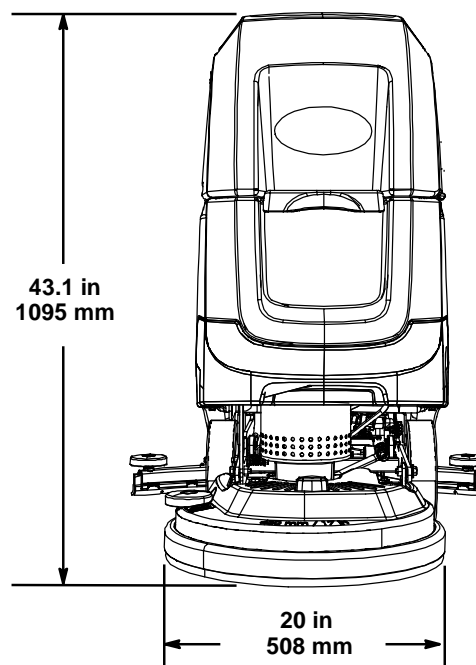
SINGLE DISK MODEL



17 in / 43 cm
Model

54 in
1372 mm

20 in / 50 cm
Model

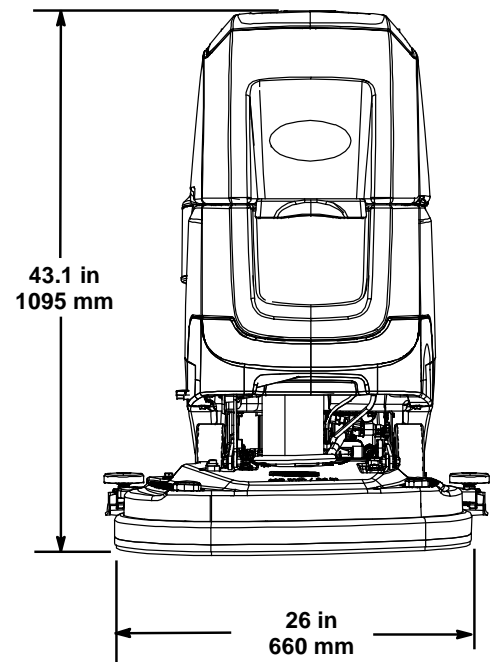
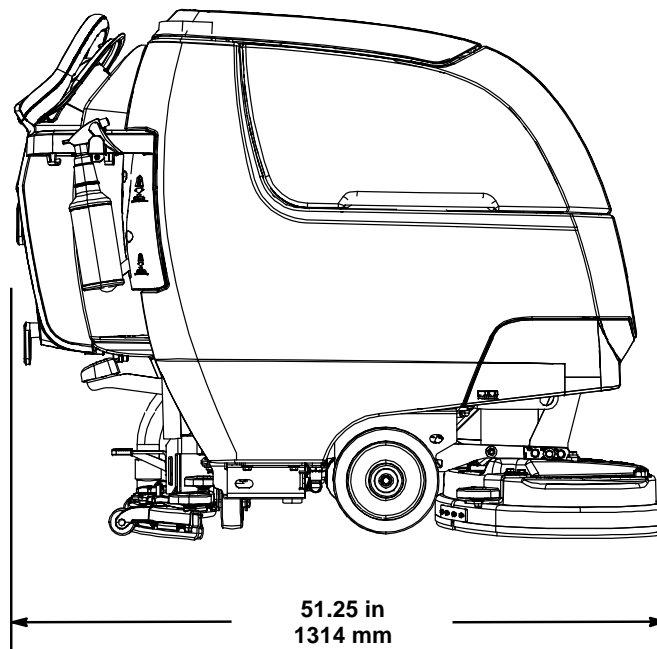
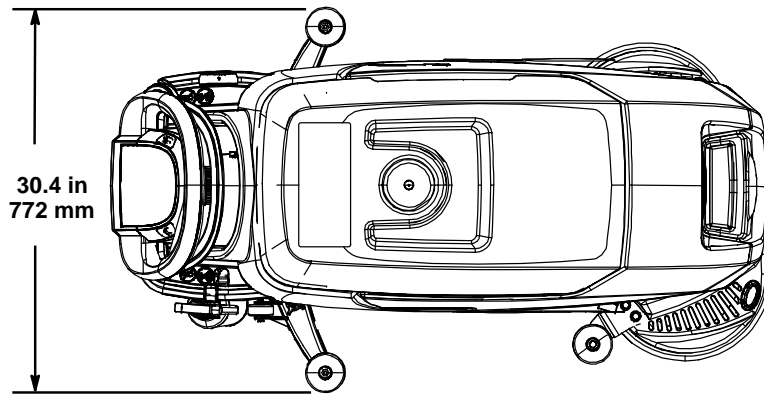


17 in / 43 cm
Model

22 in
559 mm

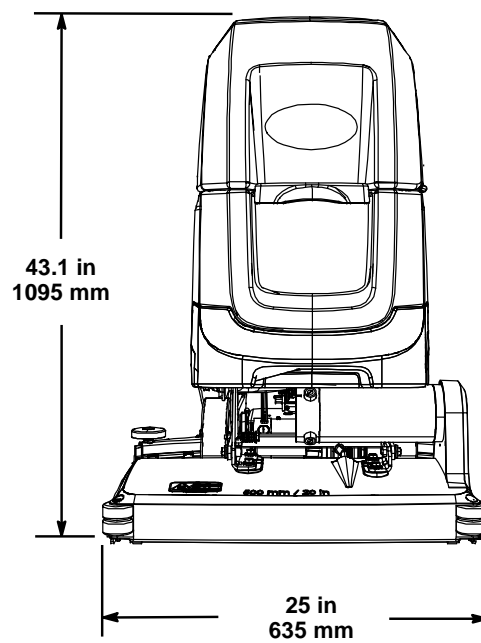
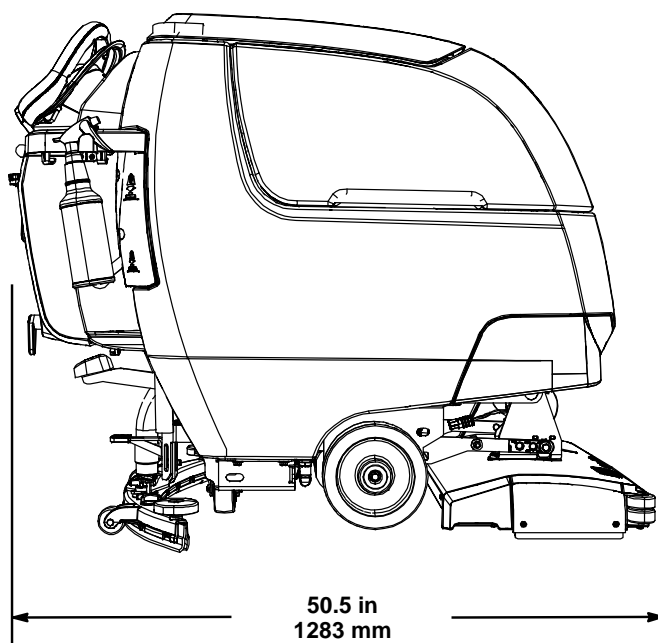
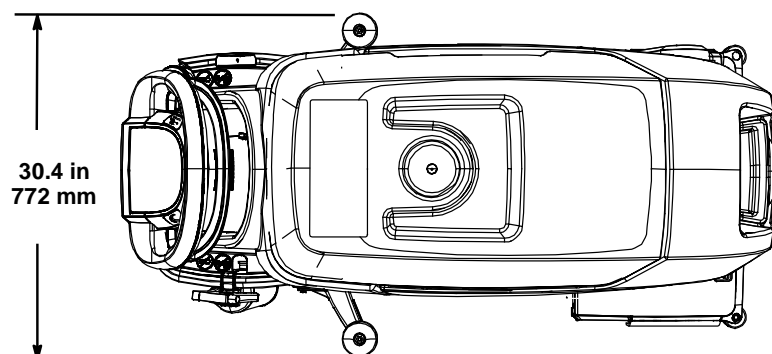
20 in / 50 cm
Model

DUAL DISK MODEL

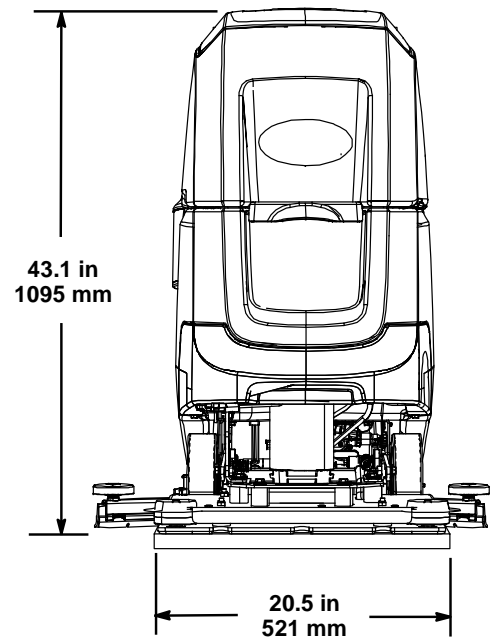
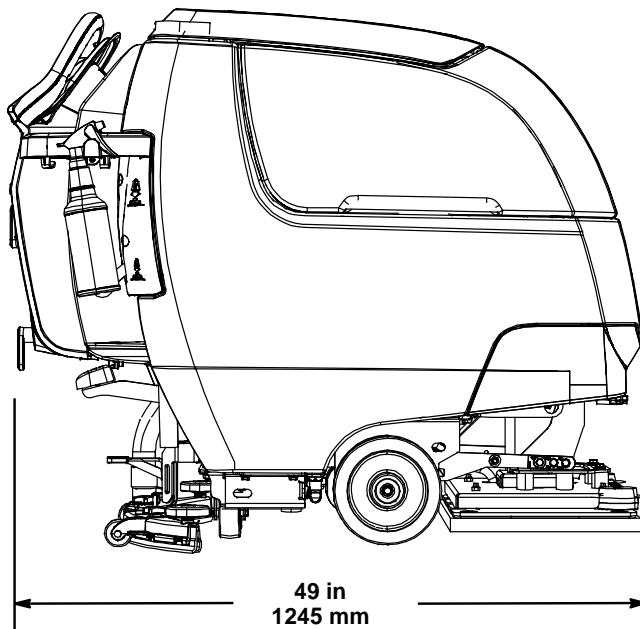
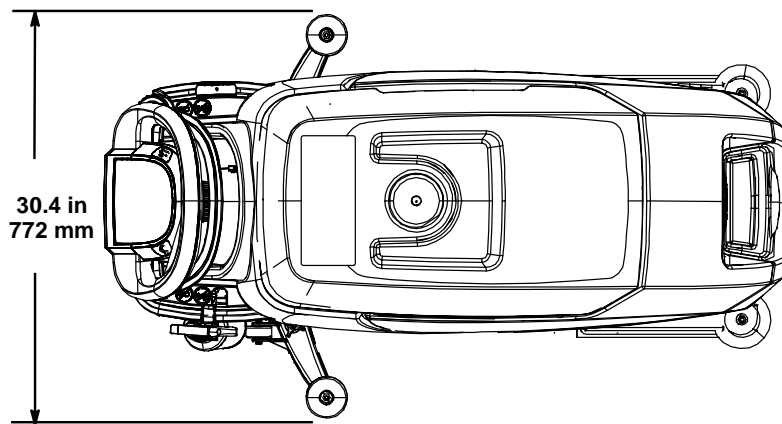


GENERAL INFORMATION

CYLINDRICAL BRUSH MODEL

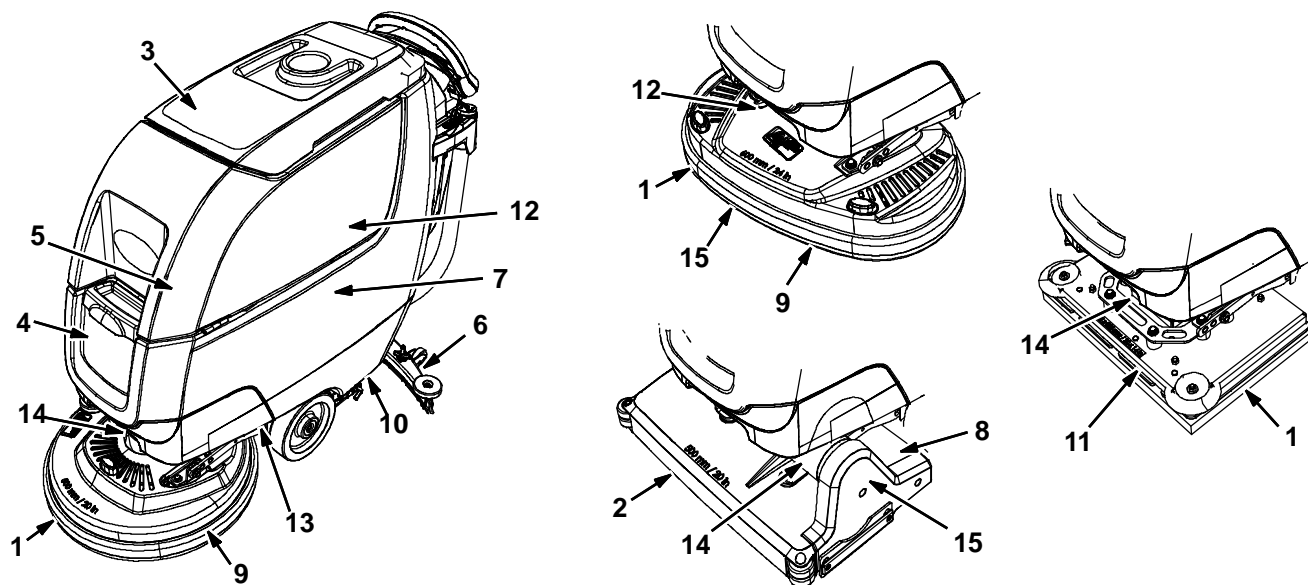


ORBITAL PAD MODEL



MAINTENANCE

MAINTENANCE CHART



Interval	Person Resp.	Key	Description	Prodecure
Dailey	O	1	Pad(s)	Check, flip or replace
	O	1	Brush(es)	Check, clean
	O	2	Cylindrical Brushes	Check, clean
	O	3	Recovery tank	Drain, rinse, clean float shut-off screen and debris tray if equipped
	O	4	Solution tank	Drain, rinse
	O	5	Severe environment tank (option)	Check, refill
	O	6	Squeegee	Clean, check for damage and wear
	O	7	Batteries	Charge if necessary
	O	8	Debris trough	Clean
	O	9	Scrub head skirt	Check for damage and wear
Weekly	O	7	Battery cells	Check electrolyte level
	O	6	Squeegee assembly drip trap reservoir	Check, clean
50 Hours	O	2	Cylindrical brushes.	Rotate brushes. Check for wear
	O	2	Cylindrical scrub head	Clean underside of scrub head
	O	3	Recovery tank lid seal	Check for wear
	O	10	Solution tank filter	Clean
100 Hours	O	7	Battery watering system (option)	Check hoses for damage and wear
200 Hours	O	7	Batteries, terminals and cables	Check and clean
500 Hours	T	11	Lower orbital isolators	Replace (4 qty)
750 Hours	T	12	Vacuum motor	Replace carbon brushes
1250 Hours	T	13	Propel motor	Replace carbon brushes
	T	14	Brush motor	Replace carbon brushes
	T	15	Brush belt	Replace belt

MACHINE MAINTENANCE

To keep the machine in good working condition, simply perform the following maintenance procedures.

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

FOR SAFETY: When servicing machine wear personal protection equipment as needed. All repairs must be performed by trained personnel.

AFTER DAILY USE

1. Drain and rinse out the recovery tank (Fig. 86). See DRAINING TANKS.



Fig. 86

2. Remove the debris tray and empty (Fig. 87).

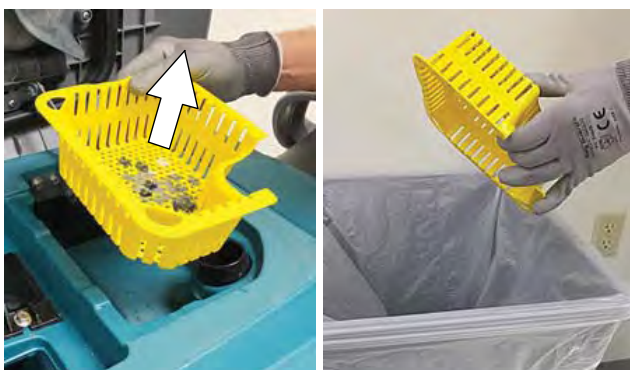


Fig. 87

3. Remove and clean the float shut-off screen (Fig. 88).



Fig. 88

4. Drain and rinse out the solution tank (Fig. 89).

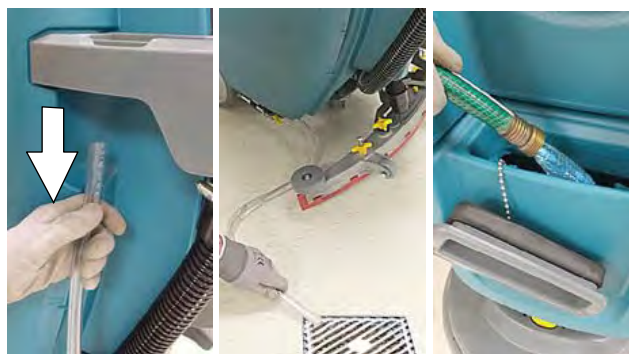


Fig. 89

5. Disk scrub head - Turn pad over or replace when worn (Fig. 90).

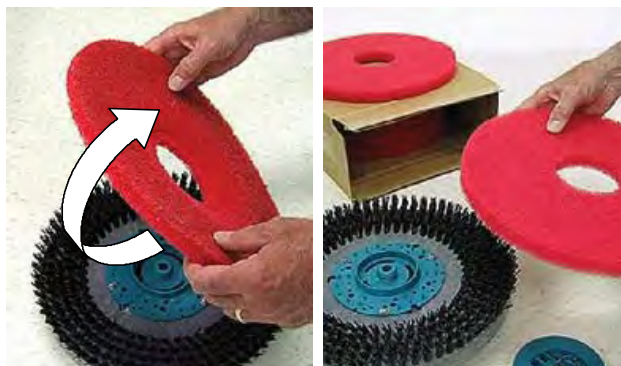


Fig. 90

MAINTENANCE

Orbital scrub head - Turn the work pad over or replace when worn (Fig. 91).



Fig. 91

6. Click-Quick pad driver/brushes - clean any debris buildup from hub connection area (Fig. 92).



Fig. 92

7. Wipe the squeegee blades clean. Inspect blades for wear and damage (Fig. 93). Rotate blade if worn. See SQUEEGEE BLADE REPLACEMENT.



Fig. 93

8. Check the scrub head skirt for wear or damage (Fig. 94). Replace if worn or damaged.



Fig. 94

9. Clean the outside surface of the machine with an all purpose cleaner and damp cloth (Fig. 95).



Fig. 95

10. Cylindrical scrub head - Remove and clean debris trough (Fig. 96).



Fig. 96

11. Charge batteries (Fig. 97). See BATTERIES.



Fig. 97

AFTER WEEKLY USE

1. Check the electrolyte level in all batteries (Fig. 98). See BATTERIES.

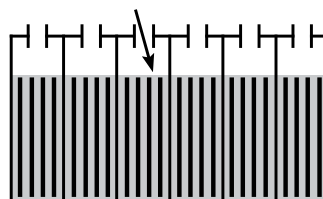


Fig. 98

2. Remove the drip tray cover from the squeegee assembly and clean reservoir (Fig. 99).



Fig. 99

MAINTENANCE

AFTER EVERY 50 HOURS OF USE

1. Remove the solution tank filter and clean screen (Fig. 100). Turn the filter bowl counter-clockwise to remove. Make sure to drain solution tank before removing filter.

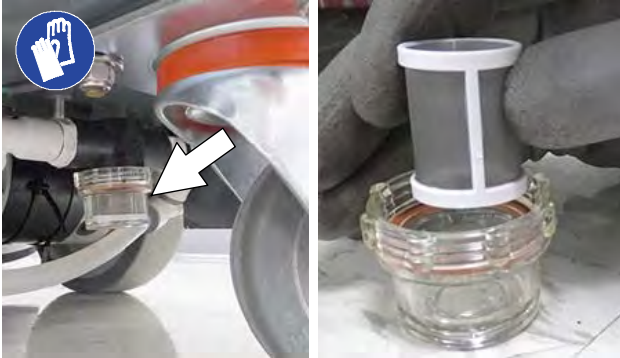


Fig. 100

2. Cylindrical brushes - Rotate brushes from front to rear (Fig. 101). Replace brushes when they no longer clean effectively.



Fig. 101

3. Cylindrical scrub head - Remove debris buildup from underside of scrub head (Fig. 102).



Fig. 102

4. Inspect and clean the seal on the recovery tank lid (Figure 104). Replace seal if damaged.



Fig. 103

AFTER EVERY 100 HOURS OF USE

If machine is equipped with the optional battery watering system, check the watering hoses and connections for damage and wear (Figure 105). Replace system if damaged.

FOR SAFETY: When servicing batteries, wear personal protection equipment as needed. Avoid contact with battery acid.



Fig. 104

ELECTRIC MOTORS

Replace motor carbon brushes as indicated. Contact-trained personnel for carbon brush replacement.

Carbon Brush Replacement	Hours
Vacuum motor	750
Propel motor (drive model)	1250
Disk brush motor	1250
Cylindrical brush motor	1250
Orbital brush motor	1250

BELTS

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

Replace belts every 1250 hours. Contact trained personnel for belt replacement (Fig. 105).

Cylindrical Brush Drive Belt

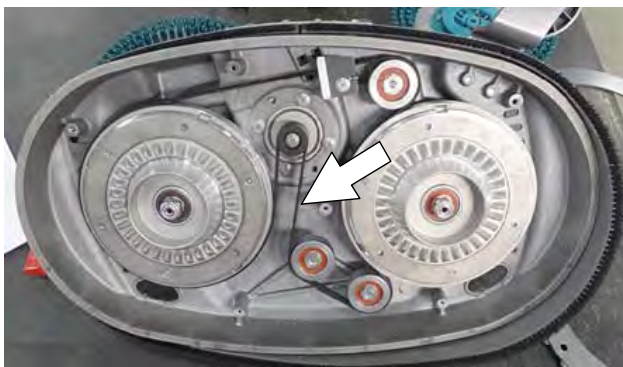
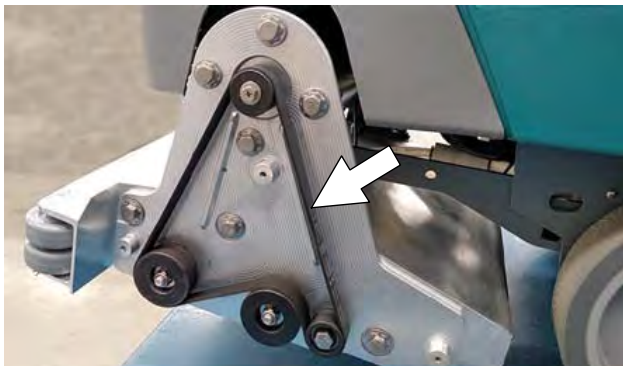


Fig. 105

ORBITAL SCRUB HEAD ISOLATORS (LOWER)

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

Replace the four lower vibration isolators every 500 hours. The lower isolators (hidden) are located between the deck plate the driver plate. See REPLACING ORBITAL HEAD, LOWER ISOLATORS in the SERVICE section of this manual.



Fig. 106

MAINTENANCE

BATTERIES

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

The lifetime of the batteries depends on their proper maintenance. To get the most life from the batteries;

- Do not charge the batteries more than once a day and only after running the machine for a minimum of 15 minutes.
- Do not leave the batteries partially discharged for long period of time.
- Only charge the batteries in a well-ventilated area to prevent gas build up. Charge batteries in areas with ambient temperatures 80_F / 27_C or less.
- Allow the charger to complete charging the batteries before re-using the machine.
- Maintain the proper electrolyte levels of flooded (wet) batteries by checking levels weekly.

Your machine is equipped with either flooded (wet) lead-acid or maintenance-free batteries supplied by Tennant.

FOR SAFETY: When servicing machine, keep all metal objects off batteries. Avoid contact with battery acid.

MAINTENANCE-FREE BATTERIES

Maintenance-free (Sealed AGM) batteries do not require watering. Cleaning and other routine maintenance is still required.

FLOODED (WET) LEAD-ACID BATTERIES

The flooded (wet) lead-acid batteries require routine watering as described below. Check the battery electrolyte level weekly.

The electrolyte level should be slightly above the battery plates as shown before charging (Fig. 107). Add distilled water if low. **DO NOT OVERFILL.** The electrolyte will expand and may overflow when charging. After charging, distilled water can be added up to about 3 mm (0.12 in) below the sight tubes.

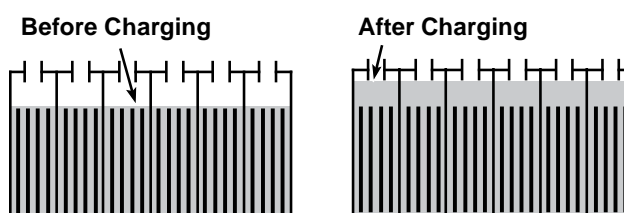


Fig. 107

NOTE: Make sure the battery caps are in place while charging. There may be a sulfur smell after charging batteries. This is normal.

CHECKING CONNECTIONS / CLEANING

After every 200 hours of use, check for loose battery connections and clean the surface of the batteries, including terminals and cable clamps to prevent battery corrosion. Use a scrub brush with a strong mixture of baking soda and water (Fig. 108). Do not remove battery caps when cleaning batteries.



Fig. 108

CHARGING BATTERIES

The charging instructions in this manual are intended for the battery charger supplied with your machine. The use of other battery chargers that are not supplied and approved by Tennant are prohibited.

If your machine is equipped with an off-board battery charger refer to the charger's owners manual for operating instructions. Contact distributor or Tennant for battery charger recommendations if machine is not equipped with charger.

FOR SAFETY: The use of incompatible battery chargers may damage battery packs and potentially cause a fire hazard.

IMPORTANT NOTICE: The battery charger is set to charge the battery type supplied with your machine. If you choose to change to a different battery type or capacity (i.e. flooded (wet) lead-acid, maintenance-free, sealed, AGM batteries, etc.), the charger's charging profile must be changed to prevent battery damage. See BATTERY CHARGER SETTINGS.

1. Transport the machine to a well-ventilated area.

WARNING: Batteries emit hydrogen gas.
Explosion or fire can result. Keep sparks and open flame away when charging.

2. Park the machine on a flat, dry surface, turn off machine and remove key.

FOR SAFETY: When servicing batteries, stop on level surface, turn off machine, remove key and set parking brake if equipped.

3. If the machine is equipped with flooded (wet) leadacid batteries check the battery electrolyte level weekly before charging. See FLOODED (WET) LEAD-ACID BATTERIES.

4. For models equipped with on-board chargers, remove the charger's power cord from the storage hooks and plug power cord into a properly grounded wall outlet (Fig. 109).



Fig. 109

For models equipped with off-board chargers, first connect the charger's DC cord into the machine's battery charge receptacle then plug the AC power supply cord into a properly grounded wall outlet (Fig. 110). Refer to the off-board battery charger's owner manual for operating instructions.

FOR SAFETY: Do not disconnect the off-board charger's DC cord from the machine's receptacle when the charger is operating. Arcing may result. If the charger must be interrupted during charging, Disconnect the AC power supply cord first.



Fig. 110

5. The charger will automatically begin charging and shut off when fully charged. The maximum charging cycle may take up to 6- 12 hours depending on battery type.

MAINTENANCE

On-board battery charger: The battery discharge indicator lights will ripple back and forth during the charging cycle. When all five lights repeatedly flash two times, the charging cycle is complete (Fig. 111).



Fig. 111

6. After charging batteries unplug the power supply cord and wrap cord around the cord hooks (Fig. 112). For models equipped with an off-board charger, Always disconnect the AC power supply cord first before disconnecting charger from machine.



Fig. 112

SQUEEGEE BLADE REPLACEMENT

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

Each squeegee blade has four wiping edges. When the blades become worn, simply rotate the blades end-for-end or top-to-bottom for a new wiping edge. Replace blade if all four edges are worn.

1. Remove the squeegee assembly from the machine.
2. Fully loosen the two outside knobs on squeegee assembly. This will separate the spring loaded blade retainer from squeegee frame (Fig. 113). To loosen the knobs quickly, squeeze the blade retainer and squeegee frame together.

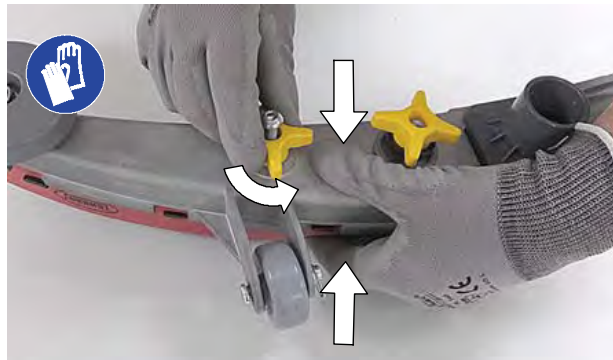


Fig. 113

3. Remove worn blade(s) from the blade retainer (Fig. 114)



Fig. 114

4. 4. Rotate the rear blade to a new wiping edge (Fig. 115). Make sure to align the slots in the blade with retainer tabs.

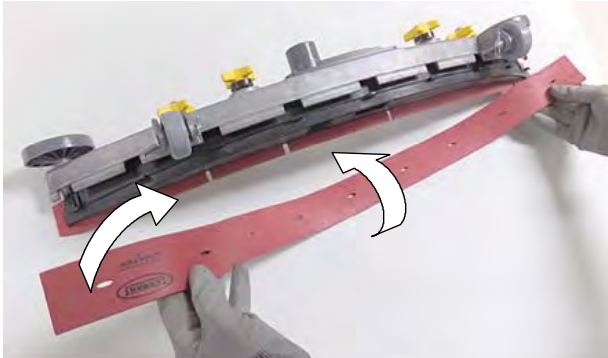


Fig. 115

5. 5. Squeeze the squeegee frame and blade retainer together and re-tighten the two outside knobs (Fig. 116).



Fig. 116

ec-H2O NanoClean WATER CONDITIONING CARTRIDGE REPLACEMENT

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and set parking brake if equipped.

The water conditioning cartridge is required to be replaced when it reaches its maximum water usage or expiration time of when the cartridge was activated, whichever comes first. The control panel will signal a code when it's time to replace cartridge.

Depending on machine usage, on average, a new cartridge can last anywhere from 12 months for heavy machine usage to 24 months for light machine usage.

ATTENTION: During first time use and after replacing the water conditioning cartridge, the ec-H2O system will automatically override the selected solution flow rate for up to 75 minutes.

1. Park the machine on a level surface, remove the key and set parking brake, if equipped.
2. Lift the recovery tank to access the ec-H2O water conditioning cartridge (Fig. 117). Drain recovery tank before lifting tank.



Fig. 117

MAINTENANCE

3. Disconnect the two hose connectors from the top of the cartridge by pressing the gray collars inward and pulling the connectors outward (Fig. 118). Lift cartridge to remove.



Fig. 118

4. Fill in the installation date on the new cartridge label (Fig. 119).



Fig. 119

5. Install the new cartridge and reconnect the two hoses. Make sure the hose connectors are fully inserted into the cartridge.
6. Reset timer for new cartridge.

Carefully read and understand all steps first before performing procedure.

- A. Turn key on.
- B. Press and hold the service switch, located on the ec-H2O module, for 10 seconds. After releasing service switch, the three solution flow indicator lights will begin to (ripple) move back and forth (Figure 129).
- C. Within 5 seconds after releasing the service switch, while the three indicator lights are moving back and forth, quickly press and release the solution flow button located on ec-H2O module (Fig. 120). The three indicator lights will then blink three times to indicate timer has been reset. Repeat process if the three

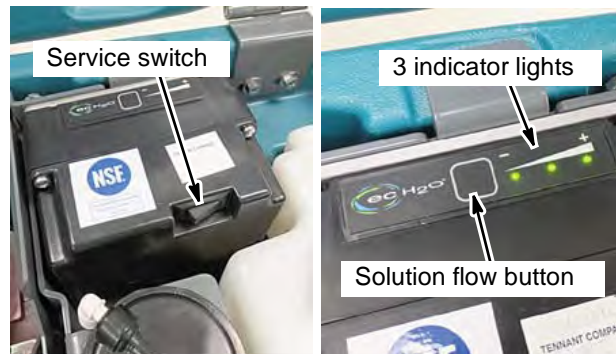


Fig. 120

LOADING/UNLOADING MACHINE FOR TRANSPORTING

When transporting the machine by use of trailer or truck, carefully follow the loading and tie-down procedure:

1. Raise the scrub head and remove squeegee assembly.
2. Use a ramp that can support the machine weight and operator and carefully load machine. Do not operate the machine on a ramp incline that exceeds a 21% grade level (Fig. 121). A winch must be used when ramp incline exceeds a 21% grade level.

FOR SAFETY: When loading/unloading machine onto/off truck or trailer, use a ramp that can support the machine weight and operator.

FOR SAFETY: Do not operate the machine on a ramp incline that exceeds a 21% grade level.

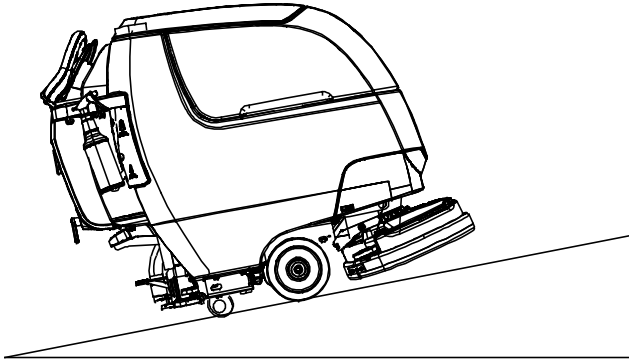


Fig. 121

3. Once loaded, position the front of the machine up against the front of the trailer or truck. Lower the scrub head, turn key off and set parking brake, if equipped (Figure 131).
4. Place a block behind each wheel (Figure 131).
5. Using tie-down straps, secure the machine using the four tie-down brackets located on the machine frame (Figure 131). It may be necessary to install tie-down brackets to the floor of your trailer or truck.

ATTENTION: Do not use control console area or accessory storage rails for tie-down locations, damage may occur.

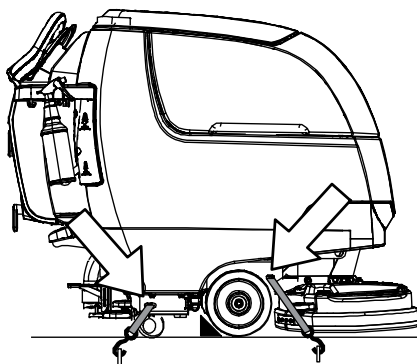


Fig. 122

STORING MACHINE

The following steps should be taken when storing the machine for extended periods of time.

1. Charge the batteries before storing machine to prolong the life of the batteries. Recharge batteries every 3 months.
2. Drain and rinse recovery tank and solution tank.
3. Store the machine in a dry area with squeegee and scrub head in the up position.

ATTENTION: Do not expose machine to rain, store indoors.

4. 4. Open the recovery tank lid to promote aircirculation.

NOTE: To prevent potential machine damage store machine in a rodent and insect free environment.

FREEZE PROTECTION

Storing machine in freezing temperatures.

1. Completely drain solution tank and recovery tank.
2. Empty the water from the solution tank filter located under machine. Replace filter.
3. Pour 1 gallon / 4 liters of propylene glycol based recreational vehicle (RV) antifreeze into the solution tank.

Models equipped with optional Severe Environment detergent tank - Lift out the tank and empty the detergent from tank. Pour a 1/4 gallon / 1 liter of propylene glycol based recreational vehicle (RV) antifreeze into the detergent tank.

4. Turn machine on and operate the solution flow system. Turn the machine off when the antifreeze is visible on floor.

Models equipped with ec-H2O option - Operate ec-H2O scrubbing to cycle antifreeze through system.

Models equipped with Severe Environment mode option - Press the Severe Environment button to cycle antifreeze through system.

5. After storing machine in freezing temperatures, drain any remaining antifreeze from the solution tank and from the optional Severe Environment detergent tank. Add clean water to solution tank and to optional detergent tank and operate the machine to flush system.

TROUBLESHOOTING


FAULTS

Machine faults are displayed three different ways depending on the machine configuration:

Machines equipped with a membrane panel display faults using the BDI (Battery Discharge Indicator). If a fault is present, the BDI displays a combination of flashing and steady LEDs, which can be interpreted using the tables below.

Machines equipped with the optional LCD panel offer additional fault detail. Note that in the table below some BDI faults correlate to several LCD fault codes that are more specific as to the circuit causing the fault.

A Service Diagnostics tool is available to provide additional fault detail. See "SERVICE DIAGNOSTICS TOOL" in the SERVICE section of this manual.

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
	0x0010	Parking Brake	Flashing indicator alerts that manual parking brake is engaged on wheel.	Release parking brake.
☼ ☼ ☼ ☼ ☼	0x	E-Stop activate fault	1. E-Stop pressed. 2. Large white iDrive connector unplugged. 3. Large white iDrive connector pin 7 disconnected. 4. iDrive power wire unplugged. 5. Scrub controller board connector J9 pin 2 disconnected. 6. Scrub controller board connector J8 unplugged. 7. Scrub controller board connector J8 pin 7 disconnected.	1. Key off machine. 2. Press and reset E-Stop button. 3. Key on machine. 4. If fault persists, check harness connections between E-Stop and control module. 5. Replace or repair harness. 6. Replace E-Stop.
● ● ● ☼ ●	0x0201	Actuator Open Warning	Wiring, connector, or control board issue on actuator.	Check connectors and connector pins.
● ● ● ☼ ☼	0x0101	Scrub Motor Open Warning	1. Wiring, connector or control board issue on scrub motor. 2. J10 connector on scrub controller board unplugged. 3. Scrub controller board power disconnected. 4. Scrub controller inline power fuse defective/blown. 5. Scrub controller board problem.	Check connections. Board gets power from key switch and battery. If connections are good, replace control board.

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ☼ ☼ ☼ ●	0x0102	Voltage/Power Loss	1. Scrub controller board not detecting power. 2. Intermittent control board power loss.	Check wiring. Inline fuse may be blown or bad. Replace inline fuse.
● ☼ ● ● ☼	0x0301	Valve Open Warning	1. Wiring, connector or control board issue with the valve. 2. Scrub Controller board connector J8 pin 2 disconnected	Check connections/wiring.
● ☼ ● ☼ ☼	0x0303	Valve Over Current Fault	1. Valve connections shorted. 2. Faulty valve. 3. Scrub Controller board damaged.	Check connections and wiring. Check valve. Replace controller board.
☼ ● ☼ ☼ ●	0x0307	Valve FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board.
● ● ☼ ● ●	0x0501	Vacuum Motor Open Warning	1. Wiring, connector or control board issue on the vacuum. 2. J10 connector on Scrub Controller board unplugged. 3. Scrub Controller board power disconnected. 4. Scrub Controller inline power fuse defective/blown.	Check connections and wiring. Board gets power from key switch and battery. Replace defective/blown inline power fuse.
● ● ☼ ● ☼	0x0601	Detergent Pump Open Warning	1. Wiring, connector or control board issue on the detergent pump. 2. Detergent pot connector unplugged. 3. Detergent pot connector Pin 5 or 6 disconnected. 4. Scrub Controller board J8 pin 1 or 6 disconnected.	Check connections/wiring.
● ● ☼ ☼ ●	0x0910	Propel Breaker Tripped Fault	1. Issue with propel motor, wiring or the I-Drive module. 2. Large white iDrive connector unplugged. 3. Large white iDrive connector pin 7 disconnected. 4. iDrive power wire unplugged. 5. Scrub Controller board connector J9 unplugged and bail activated. 6. Scrub Controller board connector J9 pin 7 disconnected.	Disconnect battery and reset the circuit breaker. Check connections/wiring.
● ● ☼ ☼ ☼	0x0901	Propel Motor Open Warning	1. Controller detects motor has become disconnected at start-up or in standby.	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, controller may be defective. Replace controller.

TROUBLESHOOTING

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x0900	Propel Generic Fault	1. Generic iDrive fault. 2. Large white iDrive connector pin 2, 8, or 9 disconnected. 3. User Interface speed pot connector unplugged.	Power cycle machine. Check connections/wiring.
	0x0903	Propel Communication Lost Warning	1. Large white iDrive connector pin 5 disconnected. 2. Small white iDrive connector unplugged. 3. Small white iDrive connector pin 3 or 4 disconnected. 4. Scrub controller board connector J2 or J8 unplugged. 5. Scrub controller board J9 pin 1 or 2 disconnected. 6. Scrub controller board J8 pin 7 disconnected. 7. Smaller of two console connectors unplugged. 8. User Interface board connector J4 or J9 unplugged.	Power cycle machine. Check connections/wiring.
	0x0904	Propel Power Cycle Needed	1. iDrive just programmed by service tech with new parameters. 2. iDrive unit is faulty.	Power cycle machine. Replace iDrive.
	0x0905	Propel Current Limit Fault	1. Controller detects motor is drawing excessive current.	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, the controller may be defective. Replace controller.
	0x0908	Propel RAM Check Error	iDrive unit is faulty.	Replace iDrive.
	0x0909	Propel Data Check Error	iDrive unit is faulty.	Replace iDrive.
	0x090A	Propel Tiller Low Reference	Controller detects Throttle Low Reference is outside of normal range. Throttle Low Reference is located on pin 8 of 14-way Tiller Connector.	Check throttle potentiometer, connectors, and relevant wiring to controller. If trip is still present after potentiometer, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x090B	Propel Gone to Sleep	Controller enters Sleep Mode.	Turn controller off and then on to wake system. To disable Sleep Mode, program parameter Sleep Timer to 0 minutes.

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x090C	Propel EEPROM Write Error	iDrive unit is faulty.	Replace iDrive.
	0x090D	Propel EEPROM Write Timeout	iDrive unit is faulty.	Replace iDrive.
	0x090E	Propel EEPROM Busy at Startup	iDrive unit is faulty.	Replace iDrive.
	0x090F	Propel EEPROM Address Range	iDrive unit is faulty.	Replace iDrive.
	0x0911	Propel Forward ISO Test Fail	Controller detects Series Speed Limit Potentiometer Wiper is shorted to one of throttle references, either high or low. Series Speed Limit Potentiometer Wiper input is located on pin 1 of 14-way Tiller Connector.	Trip is only applicable if an ISO-test resistor is fitted and programmed correctly. Check throttle potentiometer, programming, connectors, and relevant wiring to controller. If trip is still present after potentiometer, programming, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0912	Propel Forward Input Range	Controller detects an error with Throttle Wiper. Throttle Wiper input is located on pin 1 of 14-way Tiller Connector.	Check throttle potentiometer, programming, connectors, and relevant wiring to controller. If trip is still present after potentiometer, programming, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0913	Propel Joystick Error Right 2	iDrive unit is faulty.	Replace iDrive.
	0x0914	Propel Solenoid Brake	Controller detects a short circuit in solenoid brake.	Check solenoid brake, connectors and relevant wiring to controller. If trip is still present after brake, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0915	Propel Brake Status Low	iDrive unit is faulty.	Replace iDrive.
	0x0916	Propel Brake Not Connected	Controller detects an open circuit in solenoid brake at start-up or in standby.	Check solenoid brake, connectors, and relevant wiring to controller. If trip is still present after brake, connectors, and wiring have been checked, controller may be defective. Replace controller.

TROUBLESHOOTING

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x0917	Propel Brake Interlock Fault	iDrive unit is faulty.	Replace iDrive.
	0x0918	Propel Relay Interlock Fault	iDrive unit is faulty.	Replace iDrive.
	0x0919	Propel Relay Stuck Closed	iDrive unit is faulty.	Replace iDrive.
	0x091A	Propel Relay Coil Voltage	iDrive unit is faulty.	Replace iDrive.
	0x091B	Propel Watchdog Tripped	iDrive unit is faulty.	Replace iDrive.
	0x091C	Propel Positive Current Feedback Null	iDrive unit is faulty.	Replace iDrive.
	0x091D	Propel Positive Current Feedback Out of Range	iDrive unit is faulty.	Replace iDrive.
	0x091E	Propel Negative Current Feedback Null	iDrive unit is faulty.	Replace iDrive.
	0x091F	Propel Negative Current Feedback Out of Range	iDrive unit is faulty.	Replace iDrive.
	0x0920	Propel Speed Control Wiper Warning	Controller detects Parallel Speed Limit Potentiometer Wiper is open circuit or has been shorted to one of the throttle references. Parallel Speed Limit Potentiometer Wiper input is located on pin 9 of 14-way Tiller Connector.	1. Check wiring to speed control potentiometer. 2. Power cycle machine. 3. If warning persists, replace speed control potentiometer. 4. Test high and low speed functions.
	0x0921	Propel Speed Control Reference	1. Propel speed control reference incorrect.	Check wiring to speed control potentiometer. Power cycle machine.
	0x0922	Propel Throttle Trip Reference Warning	1. Propel throttle trip reference incorrect.	Check wiring to the bail sensor. Power cycle machine.
	0x0923	Propel High Battery Voltage Warning	Controller detects battery voltage has exceeded approximately 35V on 24V controllers and approximately 45V on 36V controllers.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace controller.

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x0924	Propel High Battery Voltage 2 Warning	Controller detects battery voltage has exceeded approximately 45V on 24V controllers and approximately 49.5V on 36V controllers.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after the batteries, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0925	Propel Inhibit 1 Warning	Controller detects Inhibit 1 input is active, Inhibit 1 Speed has been set to '0' and Inhibit 1 Operation has been set to 'Latched'.	Check state of input, Inhibit 1 programming, connectors, and relevant wiring to controller. If trip is still present after state of input, programming, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0926	Propel Inhibit 2 Warning	Controller detects Inhibit 2 input is active, Inhibit 2 Speed has been set to '0' and Inhibit 2 Operation has been set to 'Latched'.	Check state of input, Inhibit 2 programming, connectors, and relevant wiring to controller. If trip is still present after state of the input, programming, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0927	Propel Inhibit 3 Warning	Controller detects Inhibit 3 input is active, Inhibit 3 Speed has been set to '0' and Inhibit 3 Operation has been set to 'Latched'.	Check state of input, Inhibit 3 programming, connectors, and relevant wiring to controller. If trip is still present after state of the input, programming, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0928	Propel Watchdog Warning	1. Propel controller watchdog tripped.	Power cycle machine.
	0x0929	Propel Bad Setting Warning	1. Bad setting programmed to iDrive.	Reprogram iDrive.
	0x092A	Propel Direction Inputs Disagree	iDrive unit is faulty.	Replace iDrive.
	0x092B	Propel Positive Feedback Voltage Null	iDrive unit is faulty.	Replace iDrive.
	0x092C	Propel Positive Feedback Voltage Out of Range	iDrive unit is faulty.	Replace iDrive.

TROUBLESHOOTING

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x092D	Propel Output Voltage Tracking	iDrive unit is faulty.	Replace iDrive.
	0x092E	Propel Negative Feedback Voltage Null	iDrive unit is faulty.	Replace iDrive.
	0x092F	Propel Negative Feedback Voltage Out of Range	iDrive unit is faulty.	Replace iDrive.
	0x0930	Propel ROM Check Warning	1. The iDrive memory is corrupted. iDrive damaged.	Replace iDrive.
	0x0931	Propel EEPROM Check Warning	1. The iDrive settings are corrupted. iDrive damaged.	Replace iDrive.
	0x0932	Propel Internal 12V Error	1. The iDrive hardware is damaged.	Replace iDrive.
	0x0933	Propel Low Battery	Controller detects battery voltage has fallen below approximately 13.5V.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0934	Propel Very Low Battery	Controller detects a sudden drop in battery voltage.	Check condition of batteries, connectors, and relevant wiring to controller. If trip is still present after batteries, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0935	Propel Out of Time	iDrive unit is faulty.	Replace iDrive.
	0x0936	Propel Low Bridge Voltage	Power surge on propel module inputs causing damage to iDrive circuitry.	Replace iDrive.
	0x0937	Propel Bridge Voltage Greater Than Battery	iDrive unit is faulty.	Replace iDrive.
	0x0938	Propel Stack Overflow	iDrive unit is faulty.	Replace iDrive.
	0x0939	Propel Illegal State	iDrive unit is faulty.	Replace iDrive.
	0x093A	Propel Trip Sense Active	iDrive unit is faulty.	Replace iDrive.
	0x093B	Propel Trip Sense Not Active	iDrive unit is faulty.	Replace iDrive.

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ● ☼	0x093C	Propel Trip Latch Not Armed	iDrive unit is faulty.	Replace iDrive.
	0x093D	Propel Failed To Arm Trip Latch	iDrive unit is faulty.	Replace iDrive.
	0x093E	Propel Trip Latch Became Unarmed	iDrive unit is faulty.	Replace iDrive.
	0x093F	Propel Left Motor Shorted Low	iDrive unit is faulty.	Replace iDrive.
	0x0940	Propel Controller Fault	Each time controller trips with a suspected controller error, it records one instance of code '4401' in controller System Log. Actual controller trip code is also recorded in controller Control Log. Number of '4401' trips shown in System Log should equal cumulative number of trip occurrences shown in Control Log.	If controller continues to trip after batteries, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0941	Propel Soft Belly Button Active	Controller detects Belly Button Switch has been operated at power-up.	Check Belly Button Switch, connectors, and relevant wiring to controller. If trip is still present after switch, connectors, and wiring have been checked, controller may be defective. Replace controller.
☼ ● ● ☼ ●	0x0942	Propel Internal Temperature Sensor	iDrive unit is faulty.	Replace iDrive.
	0x0906	Propel Motor Short Low Fault	Controller detects motor wiring has been shorted to Battery Negative.	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, controller may be defective. Replace controller.
	0x0907	Propel Motor Short High Fault	Controller detects motor wiring has been shorted to Battery Positive.	Check motor, connectors, and relevant wiring to controller. If trip is still present after motor, connectors, and wiring have been checked, controller may be defective. Replace controller.

TROUBLESHOOTING

FAULTS (Cont'd)

BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ● ☼ ☼	0x0103	Scrub Motor Over Current Fault	1. Current draw higher than expected. 2. Higher current draw than hardware design limit.	Verify floor, pad, and down pressure combination are appropriate for machine. Check actuator.
	0x0104	Scrub Motor Over Current 1 Fault	1. Current draw higher than expected.	Verify floor, pad, and down pressure combination are appropriate for machine. Check actuator.
	0x0105	Scrub Motor Over Current 2 Fault	1. Current draw higher than expected.	Verify floor, pad, and down pressure combination are appropriate for machine. Check actuator.
☼ ● ☼ ● ☼	0x0902	Propel High Throttle Fault	1. Bail is activated before turning on machine. 2. Bail did not release to full rest position due to obstruction. Controller detects Throttle Potentiometer has been displaced at start-up and parameter Throttle Operated At Power-Up has been set to 'Trip'.	1. Release bail. 2. Key off and on. 3. If error persists, check for obstruction or damaged bail switch. 4. Replace switch or bail handle if damaged.
☼ ● ☼ ☼ ●	0x0107	Scrub Motor FET Fault	1. Power/battery issue on startup. 2. Control board problem.	1. Check harness/module power and ground connections. 2. Replace Control board.
	0x0207	Actuator FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum, and battery watering pump.
	0x0507	Vacuum FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum, and battery watering pump.
	0x0607	Detergent Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum, and battery watering pump.

FAULTS (Cont'd)


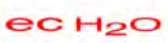

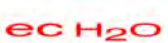
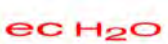
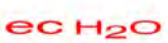
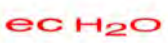
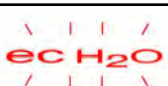
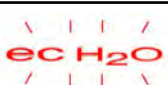


BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ● ☼ ☼ ☼	0x0503	Vacuum Over Current Fault	1. Current draw higher than expected.	Check harness and vacuum.
	0x0504	Vacuum Over Current 1 Fault	1. Current draw higher than expected.	Verify vacuum load, damage, and/or usage conditions
	0x0505	Vacuum Over Current 2 Fault	1. Current draw higher than expected.	Verify vacuum load, damage, and/or usage conditions.
☼ ☼ ● ● ●	0x0506	Vacuum Shorted Load Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	1. Check harness for damage or short between motor and control module. 2. Repair or replace harness if damaged. 3. Check for obstruction in vacuum fan assembly. 4. If not spinning freely, replace vacuum fan.
☼ ☼ ● ● ☼	0x0603	Detergent Pump Over Current Fault	1. Current draw higher than expected.	Check harness and pump.
	0x0604	Detergent Pump Over Current 2 Fault	1. Current draw higher than expected.	Verify detergent pump load, damage, and/or usage conditions
	0x0605	Detergent Pump Over Current 1 Fault	1. Current draw higher than expected.	Verify detergent pump load, damage, and/or usage conditions.
☼ ☼ ● ☼ ●	0x0606	Detergent Pump Shorted Load Fault	1. Shorted load condition. 2. Higher current draw than hardware design limit.	Check harness, pump, and control boards.
☼ ☼ ☼ ● ☼	0x0106	Scrub Motor Short Fault	1. Shorted load condition. 2. Higher current draw than hardware design limit.	Check wire harness. Repair as necessary.
● ☼ ☼ ☼ ●	0xF103	Charger CAN Communication Fault	1. Control boards are not communicating properly. 2. Board lost power (wiring issue). 3. Control board may be damaged.	1. Power cycle machine. 2. No communication with a network module. Use CANopen troubleshooting techniques.
	0xFF20	Scrub Controller CAN Communication Fault	1. Control boards are not communicating properly. 2. Board lost power (wiring issue). 3. Control board may be damaged.	1. Power cycle machine. 2. No communication with a network module. Use CANopen troubleshooting techniques.
	0x0704	EC-H2O CAN Communication Fault	1. Control boards are not communicating properly. 2. Board lost power (wiring issue). 3. Control board may be damaged. 4. ecH2O connector unplugged (never plugged in). 5. ecH2O connector pin 2 or 3 disconnected. 6. ecH2O connector power pin disconnected.	1. Power cycle machine. 2. No communication with a network module. 3. Check connections.

TROUBLESHOOTING

FAULTS (Cont'd)



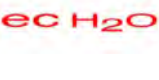



BDI (Battery Discharge Indicator) ☼ = Flashing	Pro-Panel LCD Faults (Option)	Fault Condition	Reason	Correction
☼ ☼ ☼ ● ●	0xF100	Charger Generic Warning	1. Error condition has occurred with charger unit.	Replace charger.
● ☼ ☼ ● ●	0xF101	Charger No Load Warning	1. Battery pack may not be plugged into charger. 2. Charger is bad.	1. Verify batteries are connected properly. 2. Verify wire harness continuity. 3. Replace charger.
● ☼ ● ● ●	0xF102	Charger Overheat Warning	1. Charger environment is not cool enough and cannot complete charge. 2. Charger is faulty.	1. Move machine to well-ventilated area. 2. Replace charger
● ☼ ☼ ● ☼	0xF104	Charger Timer Phase I Warning	1. Batteries not charging correctly.	Check for low battery voltage.
☼ ● ☼ ● ●	0x0703	EC-H2O Breaker Tripped Warning	1. Detected module circuit breaker trip. 2. Scrub Controller board J4 connector unplugged. 3. Scrub Controller board J4 connector pin 2 disconnected.	Power cycle machine. Check connections.
	0x0712	EC-H2O Pump Breaker Tripped Warning	1. Detected module circuit breaker trip. 2. Scrub Controller board J4 connector unplugged. 3. Scrub Controller board J4 connector pin 1 disconnected.	Power cycle machine. Check connections.
● ☼ ● ☼ ●	0x0711	EC-H2O Pump Open Warning	1. Wiring, connector, or control board issue on ec-H2O pump.	Control board is not detecting pump current. Check connections for voltage and verify pump is operating.
● ☼ ☼ ☼ ☼	0x0713	EC-H2O Pump Over Current Warning	1. Current draw higher than expected.	Check pump operating current.
	0x0717	EC-H2O Control board failure / damage	1. EC Module control board is damaged.	Replace the NanoClean Controller kit.

FAULTS (Cont'd)

Icon	Code	Fault Condition	Reason	Correction
	0x0702	EC-H2O Pressure Switch Active	The system pressure switch is detecting a trip or unconnected.	1. System pressure too high; needs repair. 2. Check connections. Verify functionality of scrub head switch and parking brake switch. Connectors possibly wired to incorrect switches.
	0x0704	EC-H2O CAN Communication Fault	1. Board lost power or CAN connection (wiring issue). 2. ec-H2O board may be damaged. 3. ec-H2O connector unplugged. 4. ec-H2O connector pin 2 or 3 disconnected.	1. Power cycle machine. 2. No communication with a network module. 3. Check connections/wiring.
	0x0708	EC-H2O System Over Regulation Warning	Cell has operated over target current condition for last 50 treated gallons.	Check water condition in solution tank for presence of detergents.
	0x0711	EC-H2O Pump Open Fault	Wiring, connector, or control board issue on ec-H2O pump.	Control board is not detecting pump current. Check connections for voltage and verify pump is operating.
	0x0713	EC-H2O Pump Over Current Fault	Current draw higher than expected.	Check pump operating current.
	0x0716	EC-H2O Pump Short Fault	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	Check EC-H2O pump and harness
	0x717	EC-H2O FET Faults	1. Power/battery issue on startup. 2. Control board problem/damage.	1. Check harness power and ground connections. 2. Replace EC water NanoClean Controller kit.
	0x0721	EC-H2O Cell Open Warning	Wiring, connector, or control board issue on the EC-H2O cell.	Refer to EC-H2O NanoClean troubleshooting guide or contact Tennant Technical Support
	0x0723	EC-H2O Cell Over Current Warning	Current draw higher than expected.	Refer to EC-H2O NanoClean troubleshooting guide or contact Tennant Technical Support
	0x0726	EC-H2O Cell Short Warning	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	Refer to EC-H2O NanoClean troubleshooting guide or contact Tennant Technical Support
	0x0727	EC-H2O Cell FET Faults	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum, and battery watering pump.

TROUBLESHOOTING

FAULTS (Cont'd)

Icon	Code	Fault Condition	Reason	Correction
	0x072A	EC-H2O Cell Electrode Fault	Cell current is operating below allowed operating condition.	See the NanoClean troubleshooting guide. Replace plumbing half of ec-H2O module.
	0x0726	EC-H2O E-Cell Short load Fault	1. Module damage. 2. Metal debris inside e-cell 3. Electronic event	Repair harness if possible. Replace EC-H2O NanoClean Module plumbing kit. Replace EC-H2O NanoClean controller kit.
	0x0741	EC-H2O WCM Pump Open Warning	Wiring, connector or control board issue on ec-H2O pump.	Check if Water Conditioning Module micro pump is connected to machine harness and verify pump is operable.
	0x0746	EC-H2O WCM Pump Short Warning	1. Shorted load condition. 2. Some higher current draw than hardware design limit.	Check harness and verify Water Conditioning Module micro pump is operable.
	0x0747	EC-H2O WCM Pump FET Fault	1. Control board problem. 2. Power/battery issue on startup.	Replace control board. FET detection includes motor, actuator, detergent pump, vacuum, and battery watering pump.
	0x0781	Detergent Tank Empty	1. Flashing icon indicates detergent tank level is too low to operate correctly. 2. Detergent tank switch connector unplugged. 3. Scrub Controller connector J4 unplugged. 4. Scrub Controller connector J4 pin 4 disconnected.	Refill detergent tank to clear indicator. If fault persists, check connections/wiring.

FAULTS - OFF BOARD BATTERY CHARGER

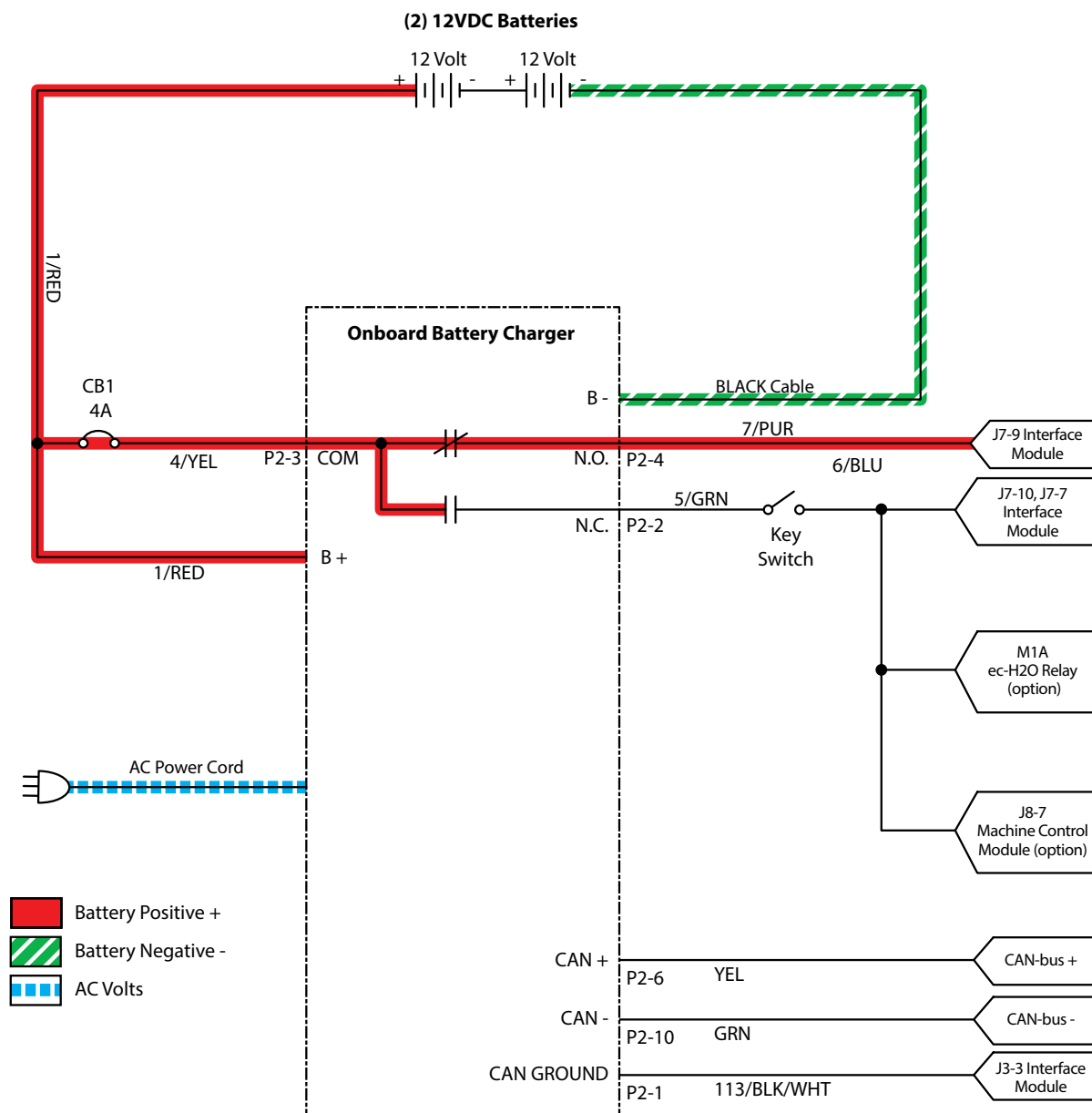
ERROR CODE	REASON	CORRECTION
Srt:IB IBmax	Output current has exceeded nominal current value by more than 10%.	Ensure there are no short circuits on battery or battery cables or there is an active load on battery that draws more current than charger can provide.
E01:Open Circuit	Current suddenly went to zero unexpectedly.	Check connection of clamps to battery and check voltage of battery elements to ensure there are no elements in an open circuit condition. Charger starts again after 5 seconds.
E02: Temperature	Internal thermic sensor has detected high temperature.	Operate charger in a well ventilated area.
E03: Timer	Safety timer of one of the phases has been activated.	Ensure charging current is set suitably for battery capacity and that selected voltage corresponds to battery voltage. Also, ensure that there are no elements in short circuit and that battery is not sulphated.

TROUBLESHOOTING

TROUBLESHOOTING

FAULT CONDITION	REASON	CORRECTION
Hour Meter Not Powered	1. Hour meter wires disconnected. 2. Scrub Controller board connector J8 pin 9 disconnected.	Check connections/wiring.
Bail Not Responding	1. Bail sensor is unplugged. 2. User Interface board defective.	Check connections. Replace user interface board.
Parking Brake Always Reporting Disengaged	1. Parking brake switch disconnected. 2. Faulty wiring. 3. Scrub Controller board connector J4 pin 6 disconnected.	Check connections/wiring. Verify functionality of parking brake switch and ecH2O pressure switch. Connectors possibly wired to incorrect switches.
Scrub Head Switch Not Functioning	1. Scrub Head switch disconnected. 2. Faulty wiring. 3. Scrub Controller board connector J4 pin 5 disconnected. 4. Scrub Controller board connector J9 pin 3 disconnected.	Check connections/wiring. Verify functionality of scrub head switch and ecH2O pressure switch. Connectors possibly wired to incorrect switches.
Vacuum Squeegee Switch Not Functioning	1. Vacuum squeegee switch disconnected. 2. Faulty wiring. 3. Scrub Controller board connector J4 pin 7 disconnected.	Check connections. Verify functionality of vacuum squeegee switch and ecH2O pressure switch. Connectors possibly wired to incorrect switches.
Reverse Switch Not Working	1. Reverse switch connector unplugged. 2. Large white iDrive connector pin 12 or 13 disconnected.	Check connections/wiring.
No Propel Response (no faults reporting)	1. Propel Motor lead unplugged. 2. Large white iDrive connector pin 1 disconnected. 3. Bail sensor is unplugged.	Check connections/wiring.
Scrub Head Not Spinning	This fault is looked up most often on a non-propel machine and no fault is reported by machine.	Verify bail switch is properly connected.
No Charge Mode LEDs	User Interface board is not receiving power from charger at J7-9.	Ensure pin connections between UI and charger connectors are not broken or unseated.

ONBOARD BATTERY CHARGING ON (Option)



BATTERIES FAILED TO CHARGE/ REDUCED RUN TIME (ONBOARD CHARGER)

STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Is there a flashing BDI fault or LCD Pro-Panel (option) fault code present? 		See "Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> Key Off Check AC power supply Is the rated AC supply voltage present? 		Go to Step #3	Check AC Supply Circuit Protection
3	<ul style="list-style-type: none"> See BATTERY CHARGER SETTINGS in the SERVICE section of this manual and confirm proper charger settings Is the onboard charger set properly? 		Go to Step #4	Reprogram battery charger
4	<ul style="list-style-type: none"> Key Off Inspect battery and charger cables for damage, corrosion, contamination or terminal problems Do any of the above conditions exist? 		Repair or Replace Battery and/or Charger Cables	Go to Step #5
5	<ul style="list-style-type: none"> Skip this step for sealed or AGM batteries Key Off Disconnect batteries Check water level of all battery cells Are the lead plates submerged? 		Go to Step #6	Add Distilled Water Until Lead Plates are Covered.
6	<ul style="list-style-type: none"> Key Off Load test all batteries (AGM or Lead-Acid) -or- Test specific gravity of each cell using a hydrometer or refractometer (Lead-Acid) Do the batteries pass a load test or are all battery cells within 0.050 (50 points) specific gravity of each other? 		Replace Battery Charger	Replace Battery or Batteries

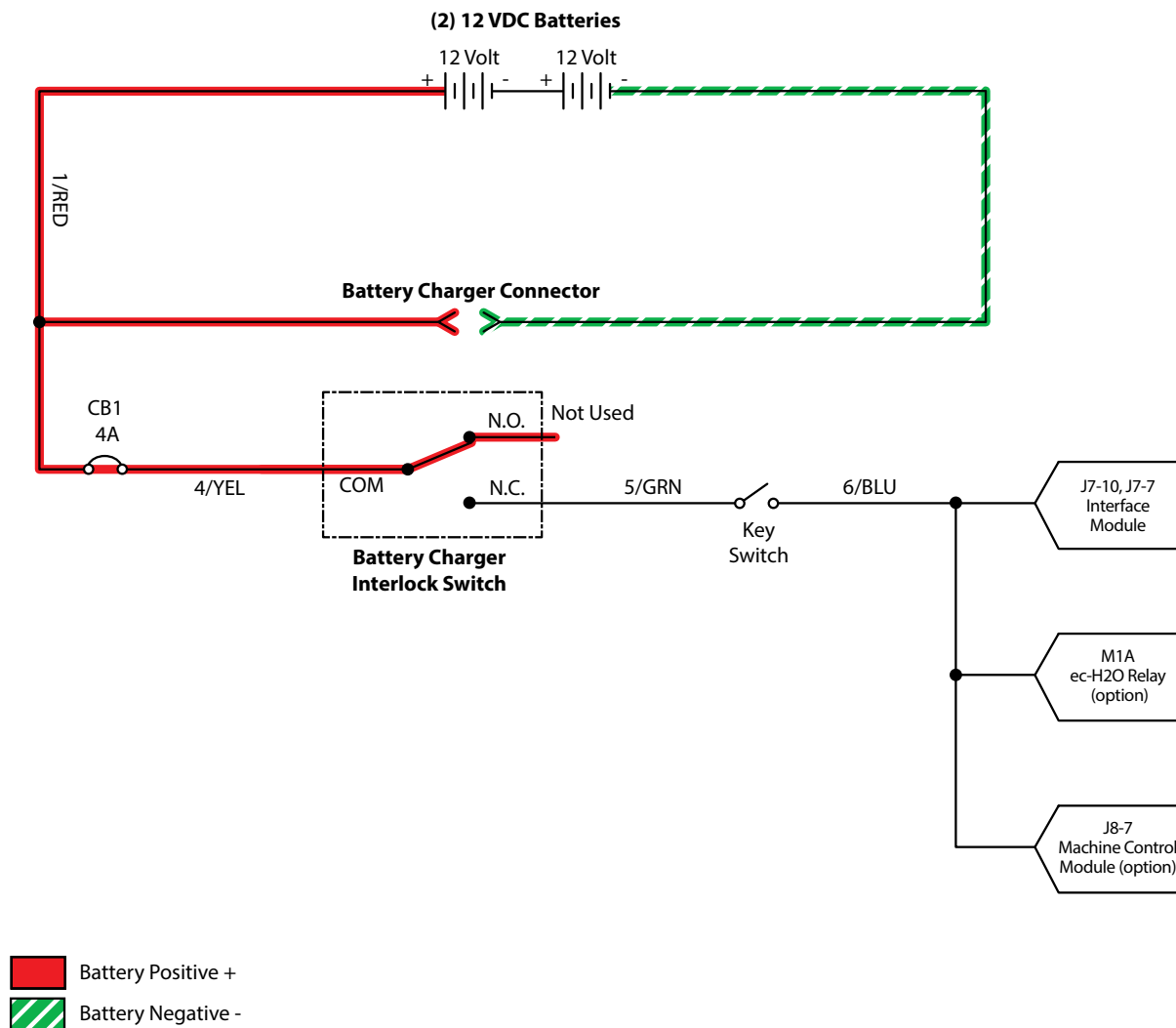
Terms:

AC = Alternating Current

AGM = Absorbed Glass Mat

Specific Gravity = Relative density of a substance compared to water (1.000 specific gravity)

OFF BOARD BATTERY CHARGING ON (OPTION)



BATTERIES FAILED TO CHARGE/ REDUCED RUN TIME (OFF BOARD CHARGER)

STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Is there an LCD fault present on the Off Board Charger? 		See "Off Board Battery Charger Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> Key Off Check AC power supply Is the rated AC supply voltage present? 		Go to Step #3	Check AC Supply Circuit Protection
3	<ul style="list-style-type: none"> Key Off Inspect battery and charger cables for damage, corrosion, contamination or terminal problems Do any of the above conditions exist? 		Repair or Replace Battery and/or Charger Cables	Go to Step #4
4	<ul style="list-style-type: none"> Skip this step for sealed or AGM batteries Key Off Disconnect batteries Check water level of all battery cells Are the lead plates submerged? 		Go to Step #4	Add Distilled Water Until Lead Plates are Covered.
5	<ul style="list-style-type: none"> Key Off Load test all batteries (AGM or Lead-Acid) -or- Test specific gravity of each cell using a hydrometer or refractometer ((Lead-Acid) Do the batteries pass a load test or are all battery cells within 0.050 (50 points) specific gravity of each other? 		Replace Battery Charger	Replace Battery or Batteries

Terms:

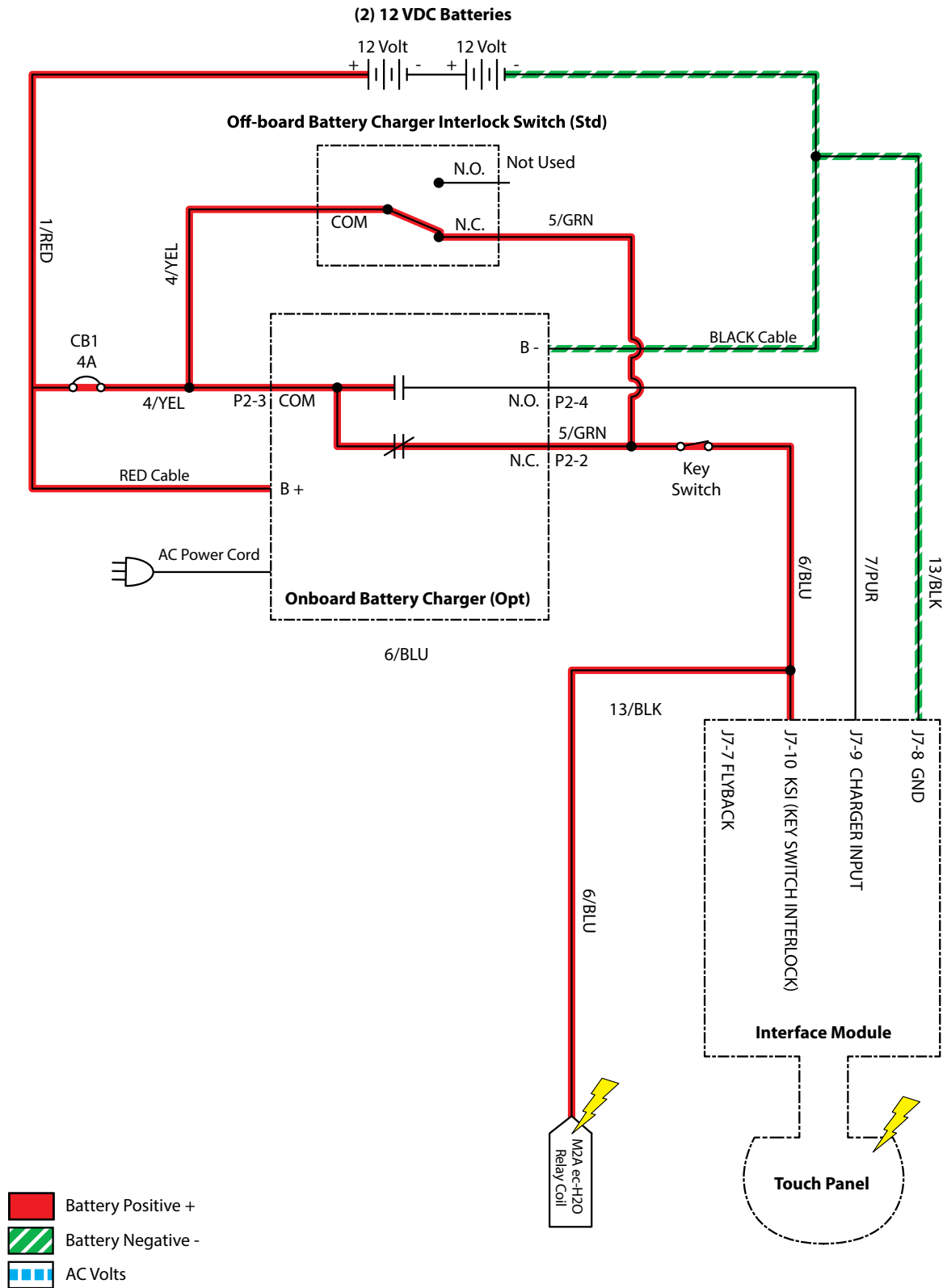
AC = Alternating Current

AGM = Absorbed Glass Mat

Specific Gravity = Relative density of a substance compared to water (water = 1.000 specific gravity)

TROUBLESHOOTING

POWER-UP ON



PMAC021

MACHINE FAILED TO POWER UP

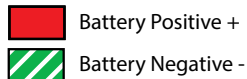
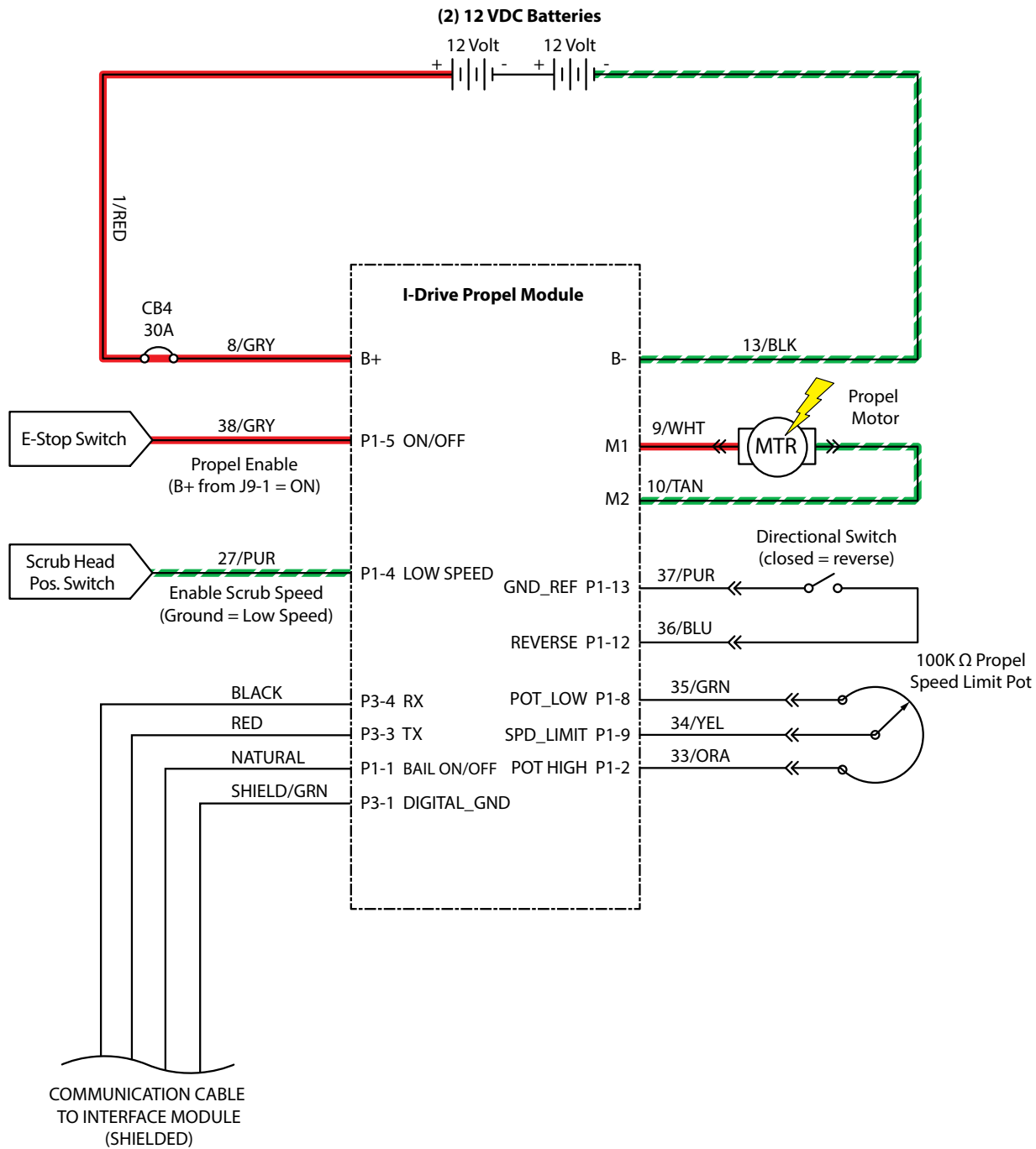
STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Test the total battery voltage using a voltmeter Is the total battery voltage greater than 20 VDC? 		Go to Step #2	Recharge Batteries and Test Power-Up Circuit Operation
2	<ul style="list-style-type: none"> Key Off Firmly press circuit breaker #1 to reset Is circuit breaker #1 tripped? 		Reset and Test Power-Up Circuit Operation	Go to Step #3
3	<ul style="list-style-type: none"> Key On Test voltage applied to the power-up subsystem as shown on the electrical schematic Are the electrical circuits operating as shown on the electrical schematic? 		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:

VDC = DC Voltage

TROUBLESHOOTING

PROPEL SUBSYSTEM (Option)



PMC021

Operational Matrix:

	Enabled	Disabled
Propel (Option)	<ul style="list-style-type: none"> Fwd/Rev Throttle Command Fwd/Rev Switch Input 	<ul style="list-style-type: none"> Battery Charger ON Interlock Neutral - Ready State PMC (Propel Motor Controller) Fault

FAILED TO PROPEL

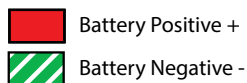
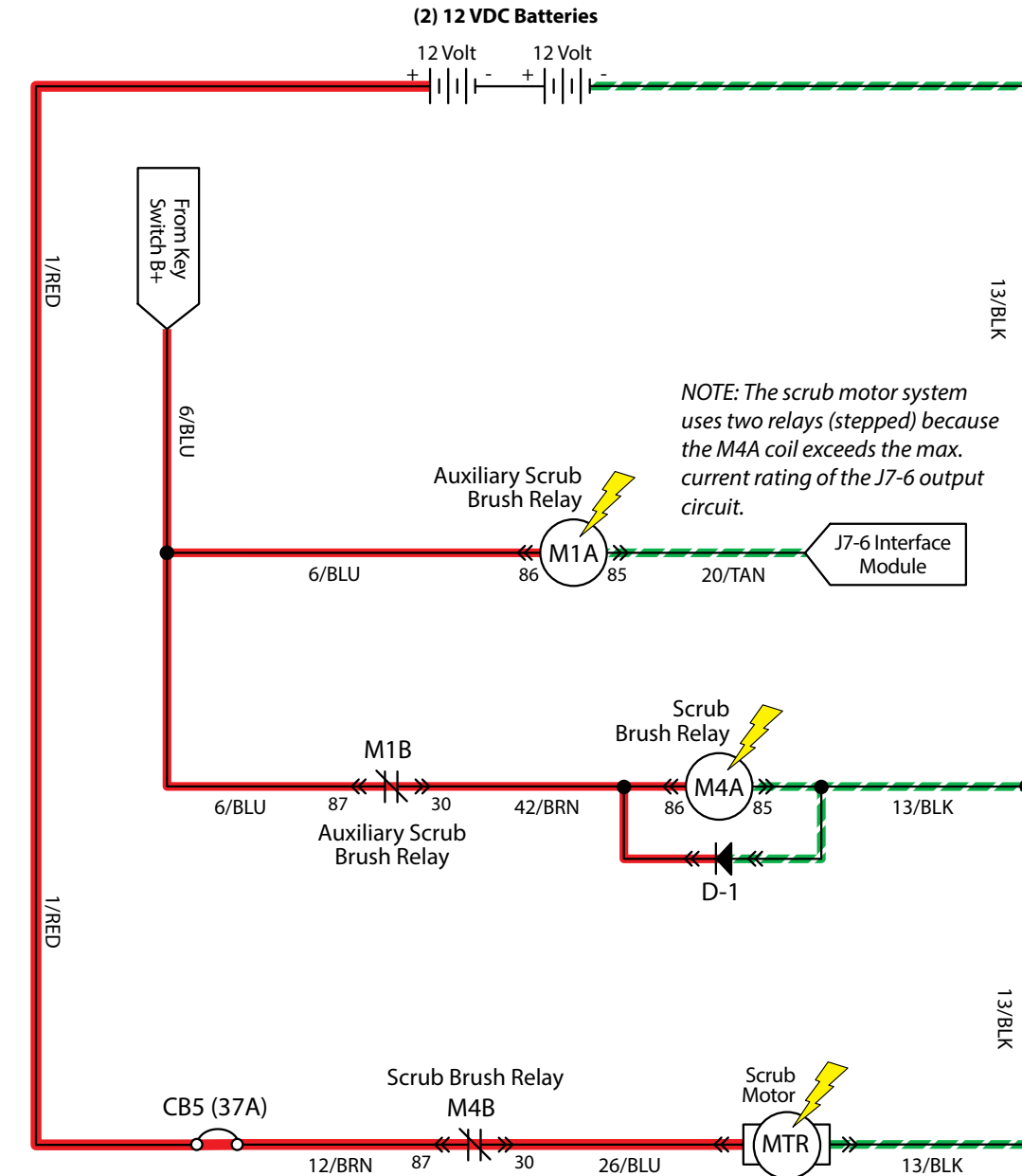
STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Enable propel Is there a flashing BDI fault fault code present? 		See "Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> See SERVICE DIAGNOSTICS TOOL in the SERVICE section of this manual and confirm the software is properly configured to enable the propel feature Is the software configured properly? 		Go to Step #3	Reprogram software
3	<ul style="list-style-type: none"> Key Off Place machine on blocks so drive wheels are lifted off the floor Key On Enable forward propel Test voltage applied to the propel subsystem as shown on the electrical schematic Are the electrical circuits operating as shown on the electrical schematic? 		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:

BDI = Battery Discharge Indicator

TROUBLESHOOTING

SCRUB MOTOR ON



Operational Matrix:

Scrub Motor

Enabled

- Head Lowered - Foot Pedal
- Fwd/Rev Throttle Command or Bail Activated on non-Propel models.

Disabled

- Head Raised - Foot Pedal
- Neutral - Ready State or Bail released on non-propel models.
- Low Battery Voltage
- Fault
- Battery Charger ON Interlock

SCRUB MOTOR FAILED TO TURN ON

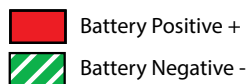
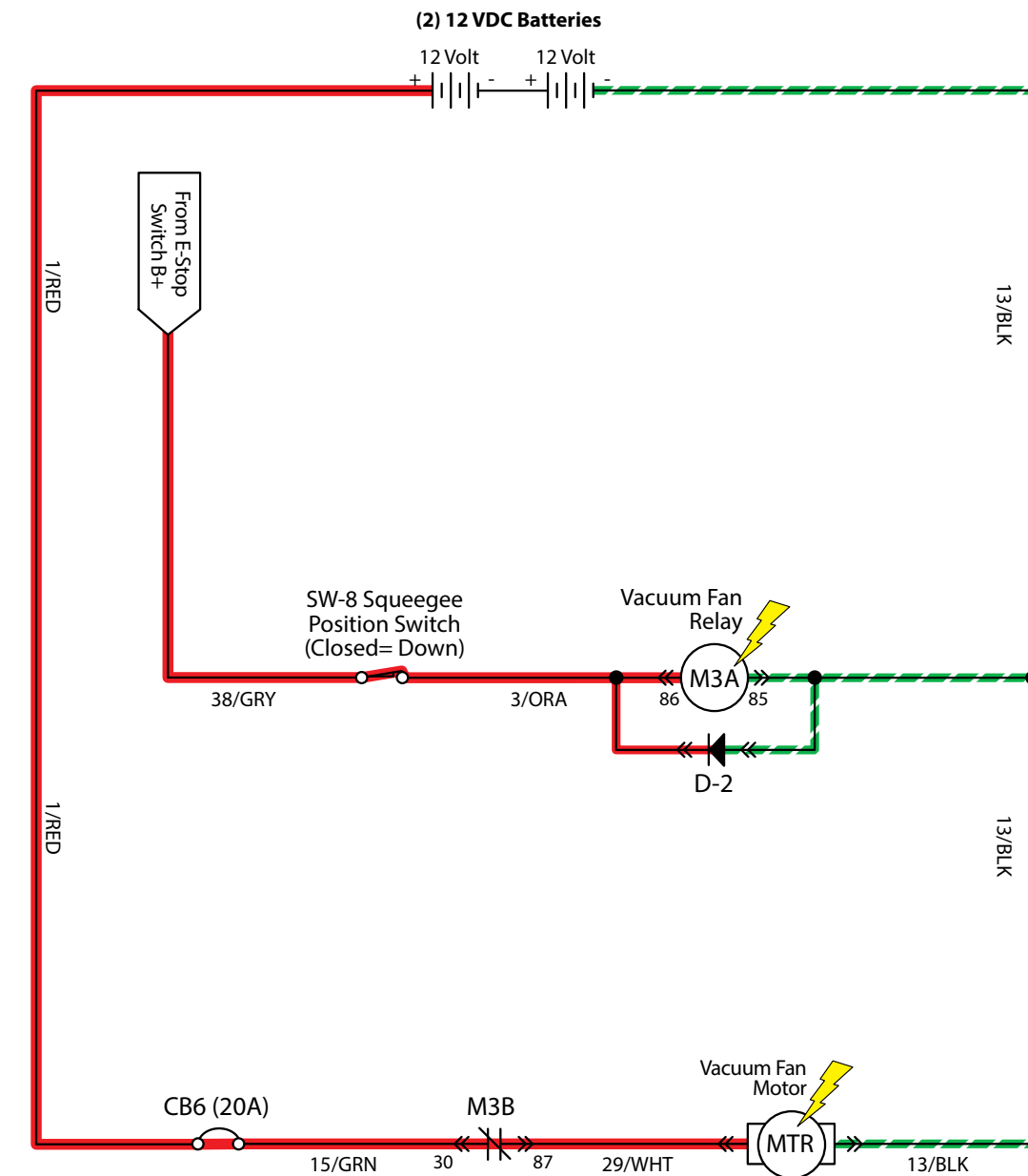
STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> • Key On • Enable scrub motor • Is there a flashing BDI fault fault code present? 		See "Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> • Key On • Enable scrub motor • Test voltage applied to the scrub motor subsystem as shown on the electrical schematic • Are the electrical circuits operating as shown on the electrical schematic? 		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:

BDI = Battery Discharge Indicator

TROUBLESHOOTING

VACUUM FAN ON



Operational Matrix:

	Enabled	Disabled
Vacuum Fan	<ul style="list-style-type: none"> Squeegee Lowered 	<ul style="list-style-type: none"> Squeegee Raised Battery Charger ON Interlock

PMCD01

VACUUM FAN FAILED TO TURN ON

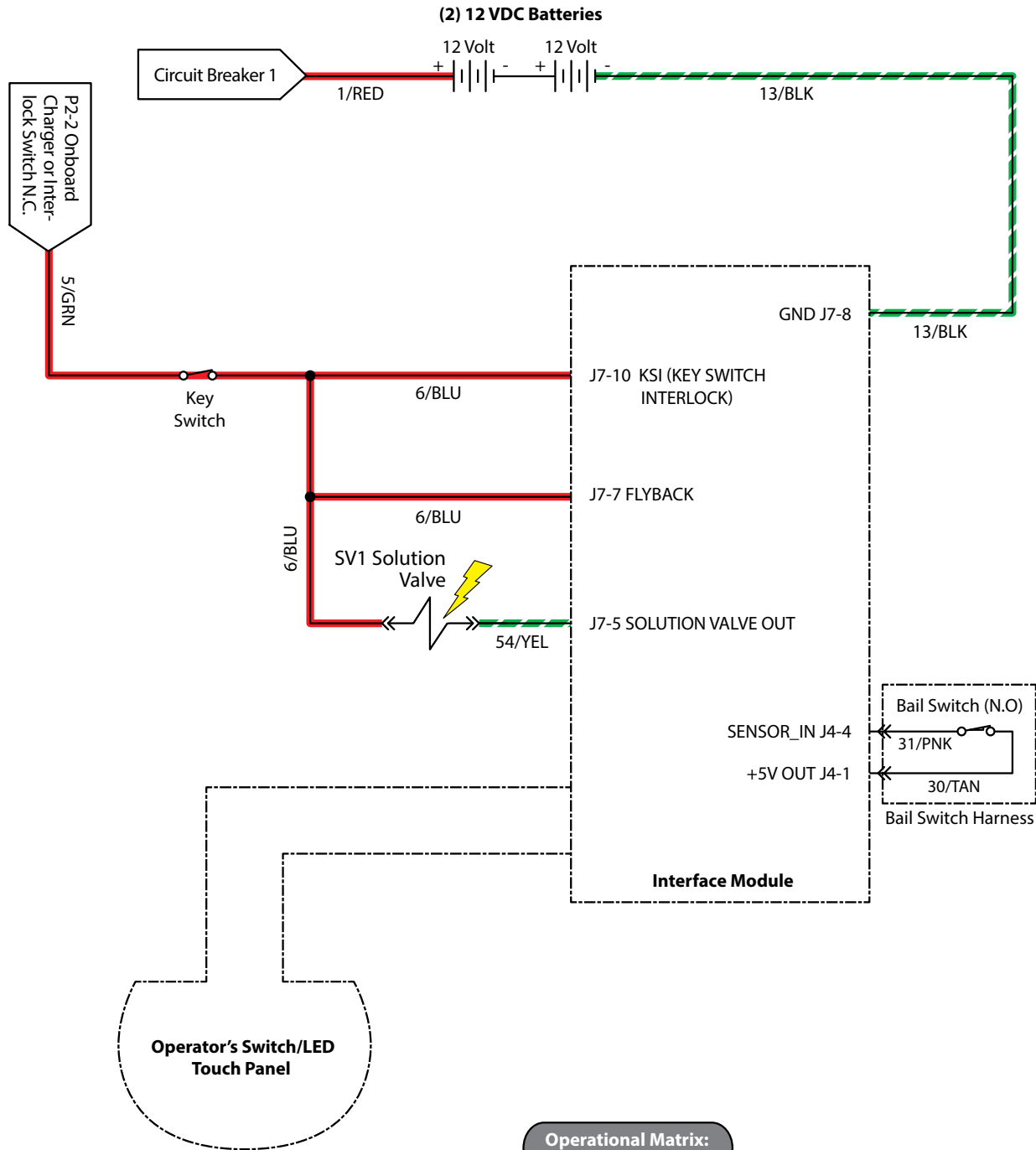
STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Enable vacuum fan Is there a flashing BDI fault fault code present? 		See "Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> Key On Enable vacuum fan Test voltage applied to the vacuum fan subsystem as shown on the electrical schematic Are the electrical circuits operating as shown on the electrical schematic? 		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:

BDI = Battery Discharge Indicator

TROUBLESHOOTING

SOLUTION CONTROL ON (CONVENTIONAL)



Operational Matrix:

	Enabled	Disabled
Solution Control (Conventional)	<ul style="list-style-type: none"> • Head Lowered - Foot Pedal • Solution Control ON • Fwd/Rev Throttle Command or Bail activated on non-propel models. 	<ul style="list-style-type: none"> • Head Raised - Foot Pedal • Solution Control OFF • Neutral - Ready State or bail released on non-propel models. • Low Battery Voltage • Fault • Battery Charger ON Interlock

PM0021

SOLUTION CONTROL FAILED TO TURN ON (CONVENTIONAL)

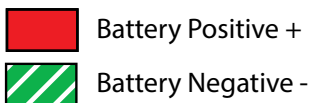
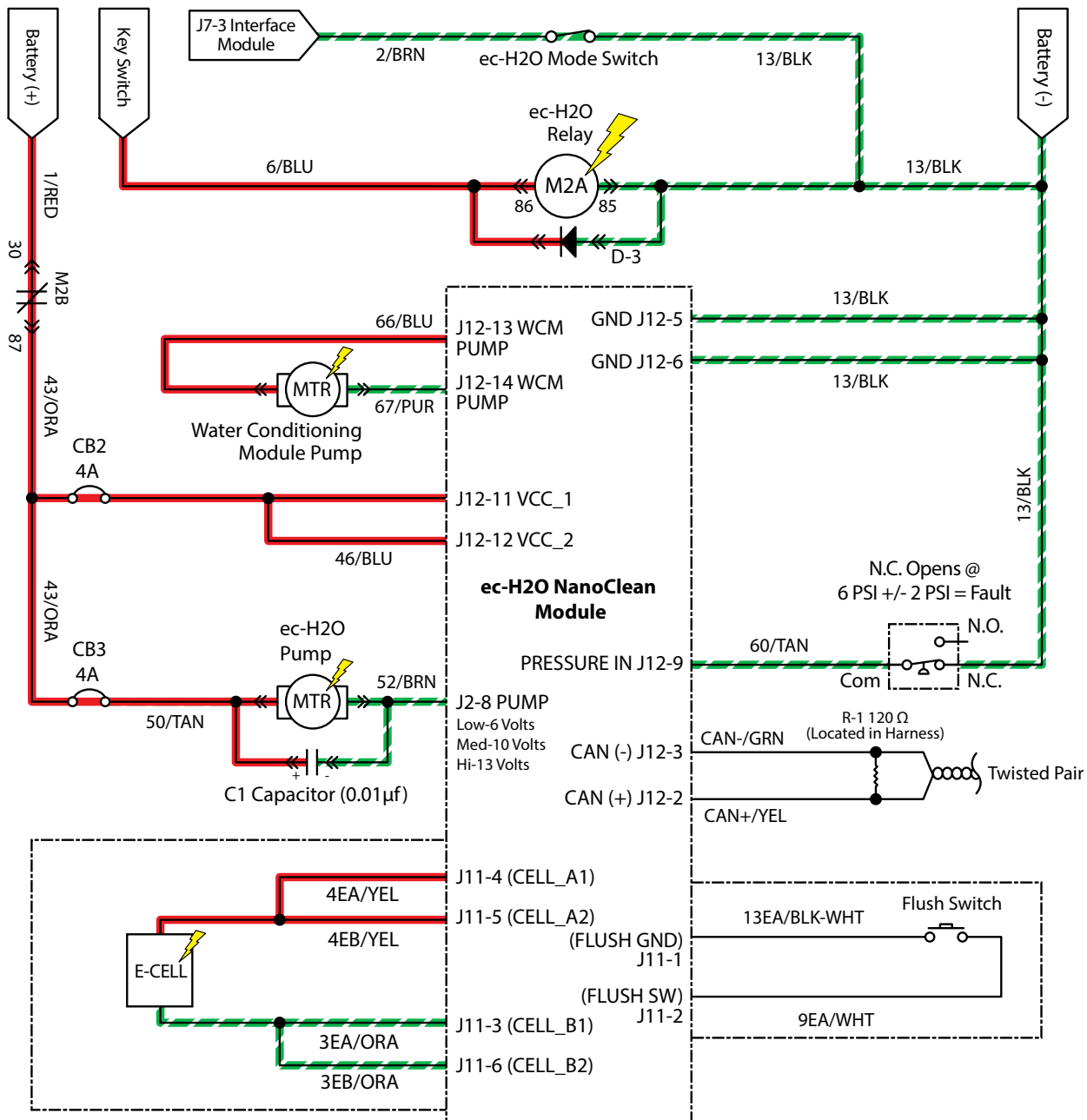
STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Enable solution control (conventional) Is there a flashing BDI fault fault code present? 		See "Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> Key On Enable solution control (conventional) Test voltage applied to the solution control (conventional) subsystem as shown on the electrical schematic Are the electrical circuits operating as shown on the electrical schematic? 		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:

BDI = Battery Discharge Indicator

TROUBLESHOOTING

SOLUTION CONTROL ON (ec-H2O)



ECCC001

Operational Matrix:

	Enabled	Disabled
Solution Control (ec-H2O)	<ul style="list-style-type: none"> Head Lowered - Foot Pedal Solution Control ON ecH2O Switch ON Fwd/Rev Throttle Command or Bail activated on non-propel models. 	<ul style="list-style-type: none"> Head Raised - Foot Pedal Solution Control OFF ecH2O Switch OFF Neutral - Ready State or bail released on non-propel models. Low Battery Voltage ecH2O System Fault Battery Charger ON Interlock

SOLUTION CONTROL FAILED TO TURN ON (ec-H2O)

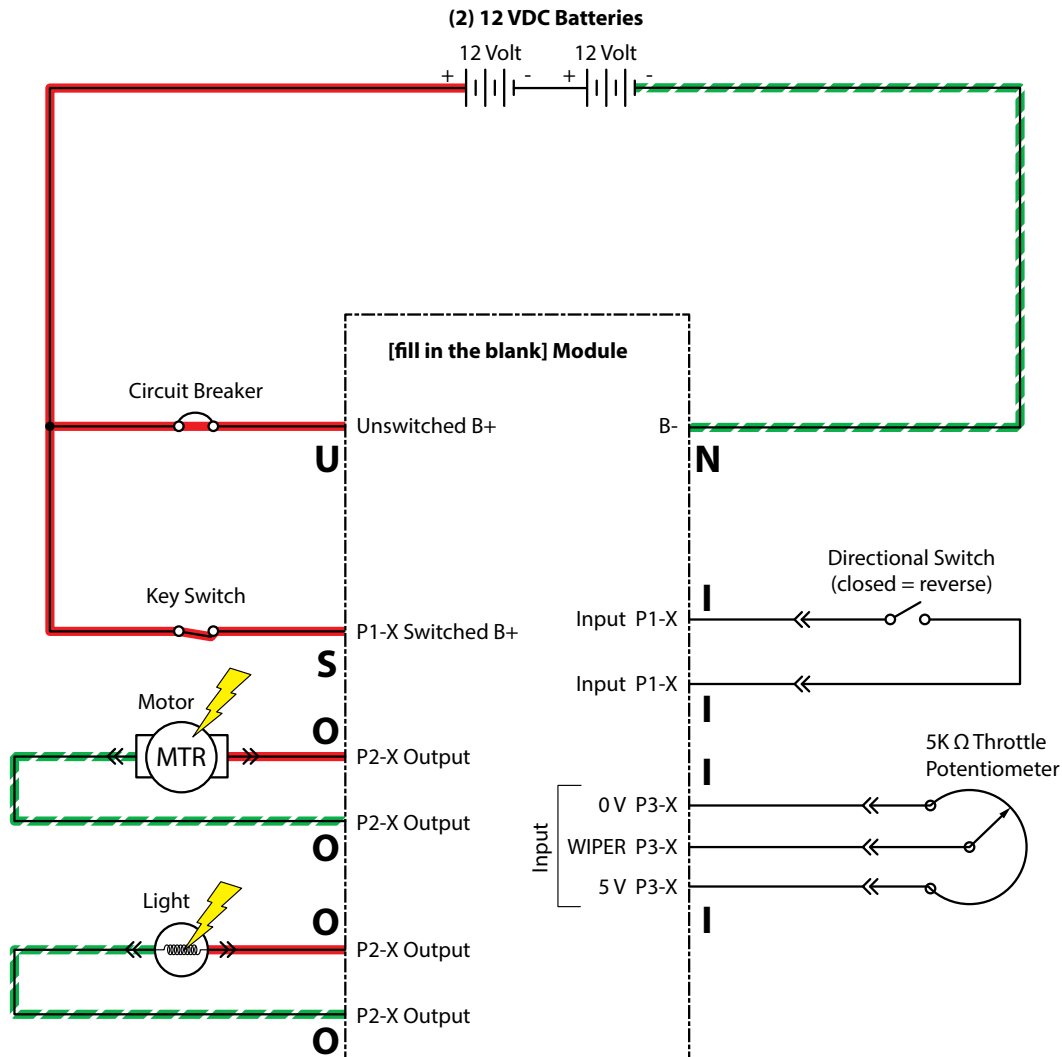
STEP	ACTION	VALUE(S)	YES	NO
1	<ul style="list-style-type: none"> Key On Enable solution control (ec-H2O) Is there a flashing BDI or ec-H2O fault present? 		See "Faults" in the TROUBLE-SHOOTING section of this manual	Go to Step #2
2	<ul style="list-style-type: none"> Key On Enable solution control (ec-H2O) Test voltage applied to the solution control (ec-H2O) subsystem as shown on the electrical schematic Are the electrical circuits operating as shown on the electrical schematic? 		Go Back to Step #1	Identify Voltage Drop Location and Repair or Replace Necessary Components

Terms:

BDI = Battery Discharge Indicator

TROUBLESHOOTING

SUN-I/O CIRCUIT BOARD TESTING (UNIVERSAL SCHEMATIC)



NOTE: The "P1-X" or sometimes "J1-X" format refers to the plug or connector number followed by the pin number within that connector. For example, P1-4 means plug number 1, pin number 4. Use this information to locate and identify proper wires per the actual electrical schematic.


S = Switched (+)


U = Unswitched (+)

N = Negative (-)

I = Inputs

O = Outputs

 Battery Positive +

 Battery Negative -

PMCD21

SUN-I/O CIRCUIT BOARD TESTING PROCEDURE

STEP	ACTION	VALUE(S)	YES	NO
1 ✓ Switched (+)*	<ul style="list-style-type: none"> Key On, circuits loaded (preferred) All electrical components remain connected to wire harness Use an electrical schematic to identify all switched (+) power supply wires Is there switched battery voltage (+) applied to the circuit board? 	Applied Voltage Must Be Within 1 Volt of Actual Battery Voltage	Go to Step #2	Identify Voltage Drop Location and Repair or Replace Necessary Components ¹
2 ✓ Unswitched (+)*	<ul style="list-style-type: none"> Key On, circuits loaded (preferred) All electrical components remain connected to wire harness Use an electrical schematic to identify all unswitched (+) power supply wires Is there unswitched battery voltage (+) applied to the circuit board? 	Applied Voltage Must Be Within 1 Volt of Actual Battery Voltage	Go to Step #3	Identify Voltage Drop Location and Repair or Replace Necessary Components ¹
3 ✓ Negative (-)*	<ul style="list-style-type: none"> Key On, circuits loaded (preferred) All electrical components remain connected to wire harness Use an electrical schematic to identify all negative(-)/ground supply wires Is there battery negative (-) applied to the circuit board? 	Applied Voltage Must Be Within 1 Volt of Actual Battery Voltage	Go to Step #4	Identify Voltage Drop Location and Repair or Replace Necessary Components ¹
4 ✓ Inputs	<ul style="list-style-type: none"> Key On Manually exercise all input devices and observe status change using a multimeter Use an electrical schematic to identify all input circuits Do all inputs function correctly? 		Go to Step #5	Repair or Replace Necessary Input Components ¹
5 ✓ Outputs	<ul style="list-style-type: none"> Key On Disconnect battery and circuit board from wire harness and test output circuits for open or shorted circuits using an Ohmmeter. Use an electrical schematic to identify all output circuits Is there an open or shorted ² output circuit causing the trouble symptom? 		Repair or Replace Necessary Output Circuit Components ¹	Replace Circuit Board.

¹ Wire harnesses are components.

² An open circuit has infinite resistance "O.L.". A shorted circuit has "0" resistance. Always test through the entire circuit.

* Switched (+) and Unswitched (+) indicate positive battery voltage applied to the circuit board. Negative (-) indicates battery negative (ground) as part of the power supply to the circuit board.

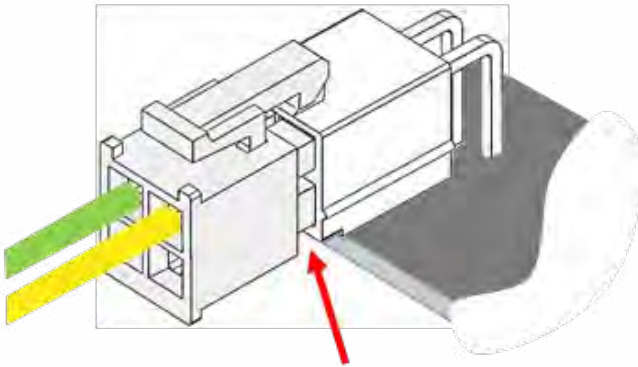
TROUBLESHOOTING

CAN OPEN NETWORK ISSUES

The following items include procedures to help investigate a fault related to a CAN open network on the machine.

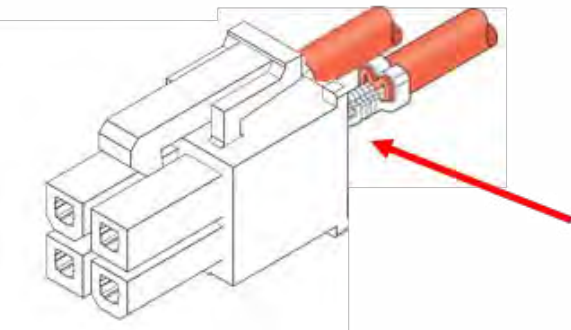
CONNECTORS FULLY SEATED

Each node on the network has a connector for the CAN communication wires. A loose connection could cause a fault code error. Check each board individually to make sure the connectors are fully seated. There may also be other connectors within the harness that should be checked. If the connector is not fully seated, push in and power cycle the machine to see if the fault clears.



PIN FULLY SEATED

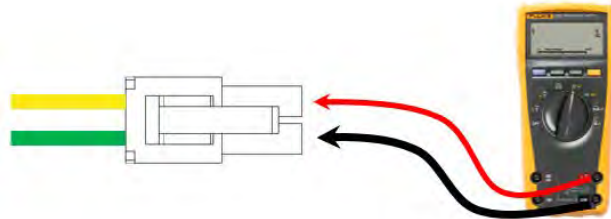
A pin within the harness side of the connector may not be fully seated or may come loose over time causing a fault. If the pin is not fully seated, push it back in and power cycle the machine to see if the fault clears.



NETWORK RESISTANCE

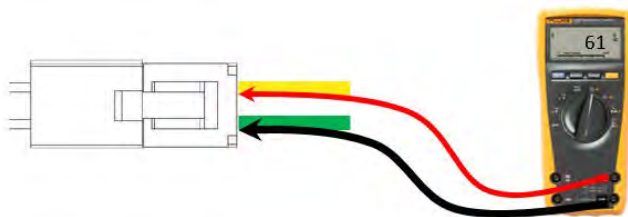
The network resistance must be correct for the network to operate correctly. Depending on which node the measurement is taken at and the method of measurement, the resistance may be one of two values: 121 or 61 Ohms. Any value other than these two means something is wrong with the network.

Method 1



6. Turn off machine power.
7. Locate a CAN node location on the machine.
8. Disconnect the connector containing the CAN wires.
9. Measure the resistance between the green and yellow wires.
10. Depending which nodes are still connected, resistance should be 61 or 121 ohm.

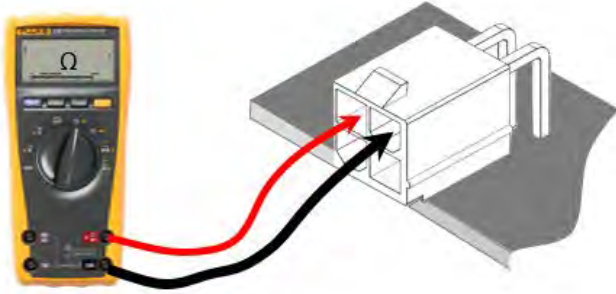
Method 2



1. Turn off machine power.
2. Locate a CAN node location on the machine.
3. Carefully push probes into back of connector containing the CAN wires.
4. Since network remains connected in this mode, resistance should measure approximately 61 ohms.

NODE (MODULE) RESISTANCE

Each node on the network has a connector for the CAN communication wires. Check each board individually to make sure the CANH and CANL resistance measurements are $> 1\text{M } \Omega$ for non-terminating nodes and $122\text{ } \Omega$ for terminating nodes. The CAN connections may be on their own connector (pictured below) or combined into another connector. See specific machine schematic for more details.



WIRE CONTINUITY TO NODE

A check can be made between two points on the harness verifying continuity of the wire harness. Check the yellow to yellow connections and the green to green.



TROUBLESHOOTING

MACHINE NODE TABLE

The following table outlines the CAN nodes by machine model. A standard node is one that is always present. Optional nodes are dependent on the customer order. Gray box = Terminating Resistor Locations. If only one box marked on a machine, the second termination is made in the harness.

Machine model	Nodes									
Master/Slave	Master	Slave								
Optional Nodes	Standard	Standard	Standard	Standard	Standard	Standard	Optional	Optional	Optional	Optional
SS300	User Interface	-	-	-	-	-	Charger	EC H2O	-	-

SERVICE

SERVICE DIAGNOSTICS TOOL

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced in the field or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service has this software installed on their *ServiceLink* devices.

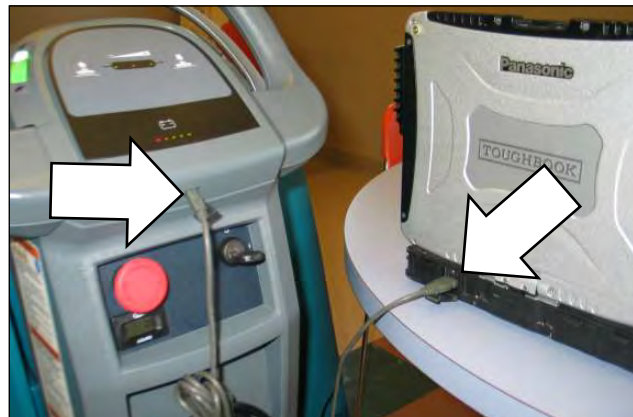
A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

- Interface Module: The interface module is located in the operator's console.
- Machine Control Module: The machine control module is located at the rear of the battery compartment beneath a cover.
- I-Drive Propel Module (option): The I-Drive propel module is located above the rear squeegee assembly at the rear of the scrubber..
- Onboard Battery Charger Module (option): The onboard battery charger is located at the rear of the unit, beneath the plastic cover.
- ec-H2O NanoClean Module (option): The ec-H2O module is located in the front of the unit, beneath the recovery tank.

PROGRAMING A NEW INTERFACE MODULE

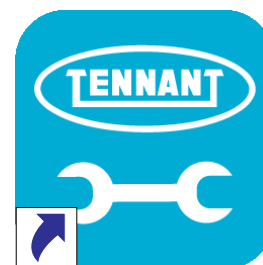
SYSTEM REQUIREMENTS: Windows® 7 OS, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

5. Connect a USB cable from a notebook computer to the machine and turn the key switch On.



6. Launch the software by double clicking the *Service Diagnostics* desktop shortcut or find the software in *All Programs*.

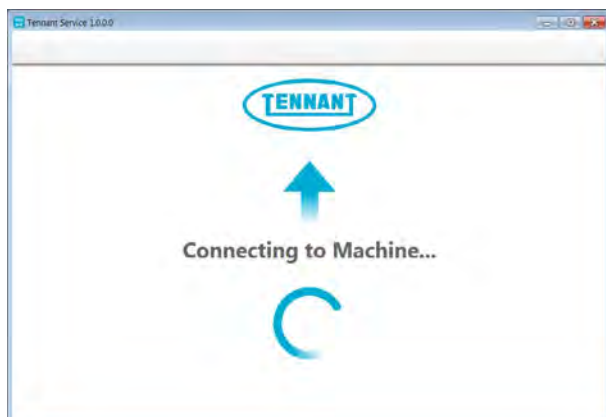
NOTE: Windows® may prompt a restart after installing the machine driver. Decline the restart, close *Service Diagnostics* and relaunch *Service Diagnostics*.



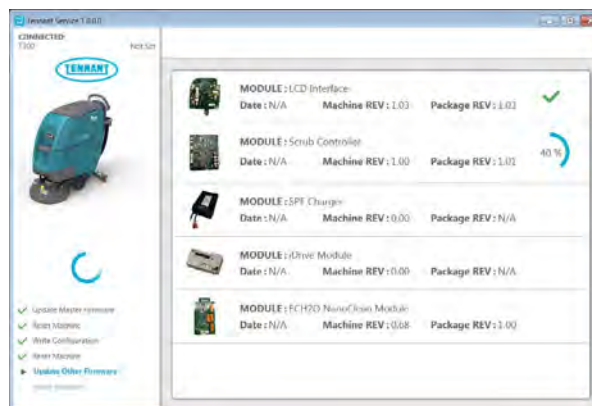
Service
Diagnostics

SERVICE

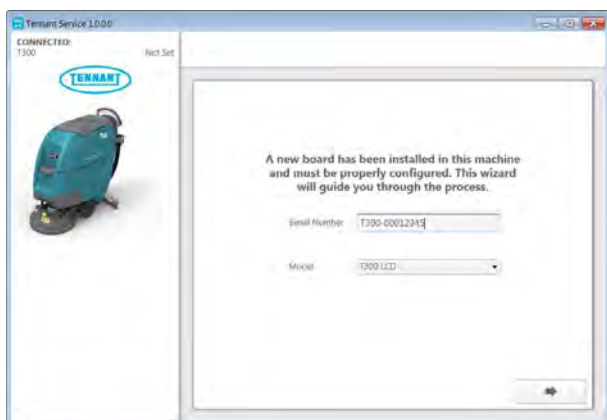
- The Service Diagnostics tool now connects to the control module network.



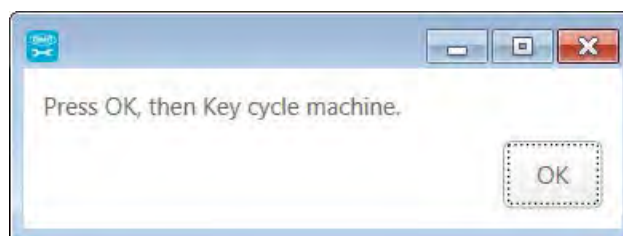
- The programming process begins and all of the control modules are updated (if applicable).



- The Service Diagnostics tool will automatically detect a new interface module installation. Enter the model and serial number and then click on the arrow button.

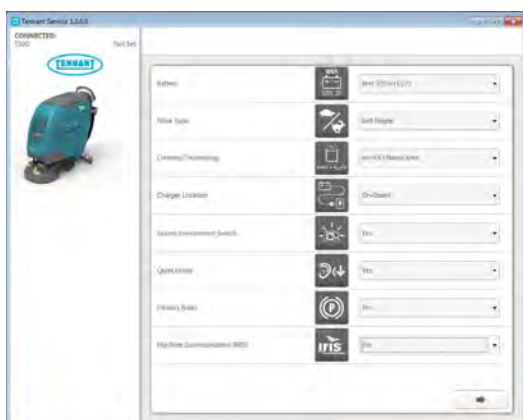


- The Service Diagnostic tool may prompt to cycle the key switch off/on during the process. If prompted, click on the OK button and then cycle the key switch to allow the programming to continue.



- Cycle the key switch to save selections.

- Inspect the actual machine configuration and match applicable configurations from the drop-down menus and then click on the arrow button.



RE-CONFIGURING EXISTING MODULES

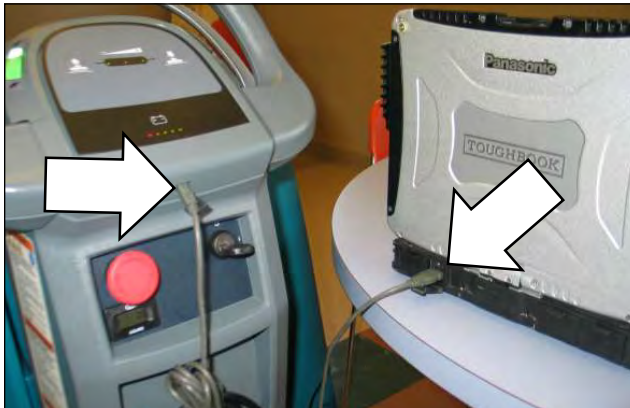
SYSTEM REQUIREMENTS: Windows® 7 OS, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced in the field or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service has this software installed on their ServiceLink devices.

A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

1. Connect a USB cable from a notebook computer to the machine and turn the key switch On.



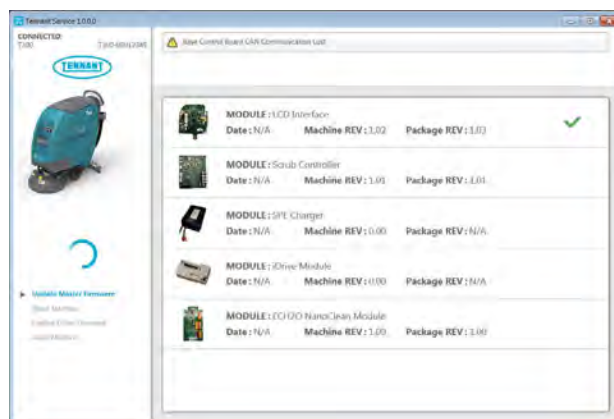
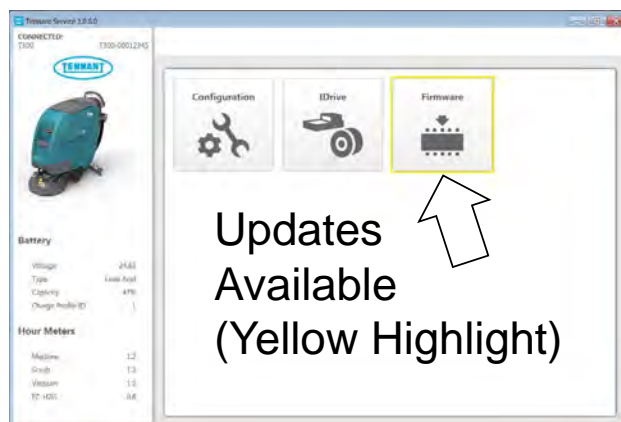
2. Launch the software by double clicking the *Service Diagnostics* desktop shortcut or find the software in *All Programs*.

NOTE: Windows® may prompt a restart after installing the machine driver. Decline the restart, close *Service Diagnostics* and relaunch *Service Diagnostics*.



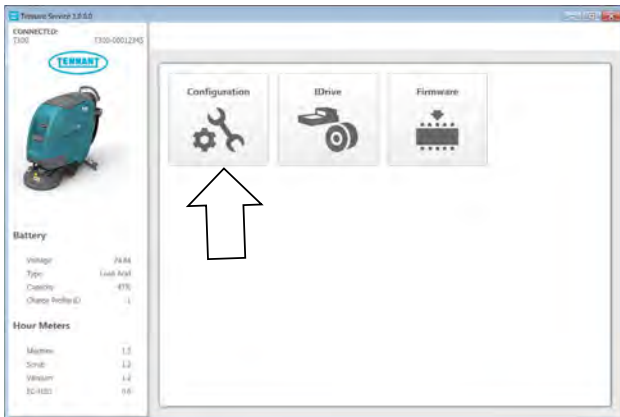
Service
Diagnostics

3. Check for machine software updates. A yellow highlight surrounding the Firmware button indicates that updates are available. Click on the Firmware button to install updates.

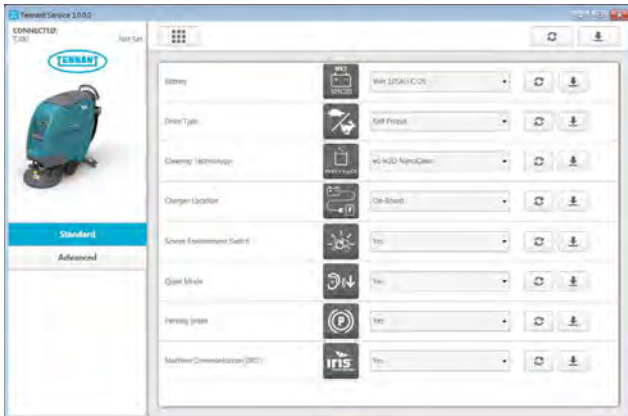


SERVICE

- Click on the Configuration button to display a list of configurable options.



- Select all of the desired re-configurations that apply from the drop-down menus and then click individual arrow buttons to launch *individual* module re-programming (this is faster) or the header arrow button to launch *all* module re-programming (this is slower). Click on the refresh button to display the new configuration following reprogramming.



- Cycle the key switch to save changes.

PROGRAMMING THE I-DRIVE MODULE (OPTION)

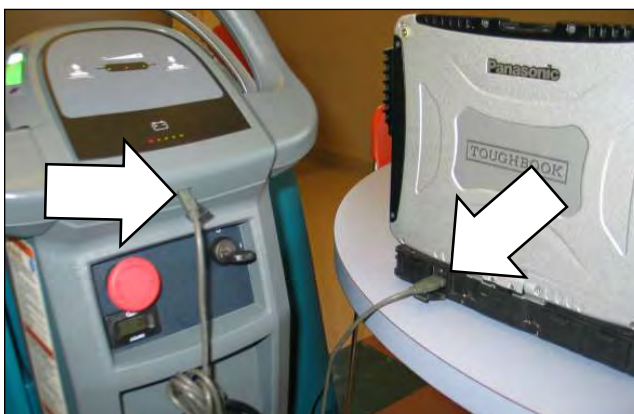
SYSTEM REQUIREMENTS: Windows® 7 OS, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

Machine software configuration, which is stored in the interface module, must be programmed if the i-Drive or interface modules are replaced in the field or if optional features are installed in the field.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service has this software installed on their ServiceLink devices.

A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

1. Connect a USB cable from a notebook computer to the machine and turn the key switch On.



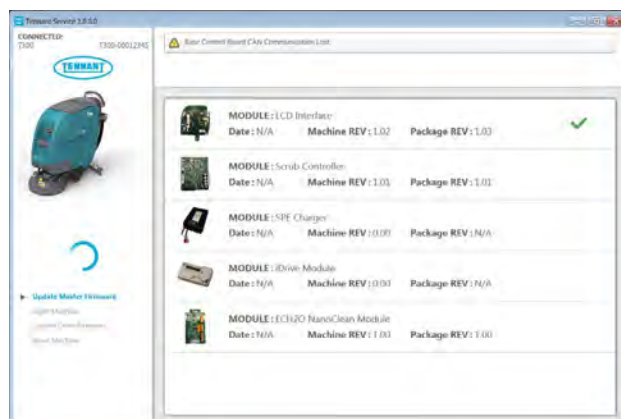
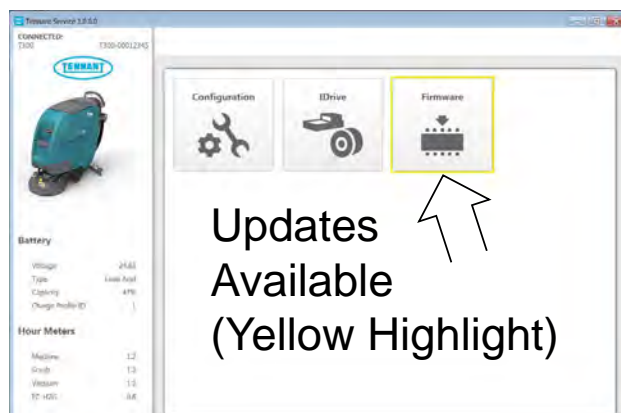
2. Launch the software by double clicking the Service Diagnostics desktop shortcut or find the software in All Programs.

NOTE: Windows® may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics and relaunch Service Diagnostics.



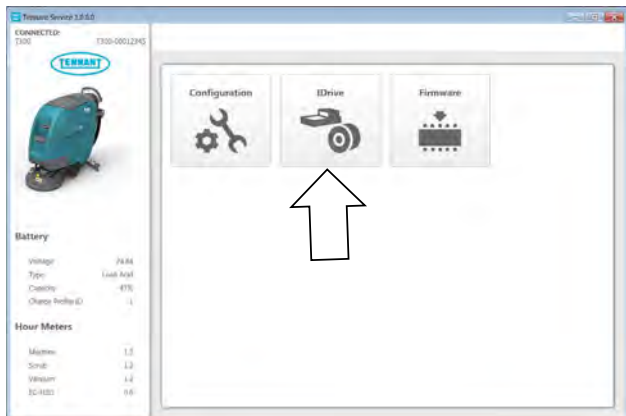
Service
Diagnostics

3. Check for machine software updates. A yellow highlight surrounding the Firmware button indicates that updates are available. Click on the Firmware button to install updates.

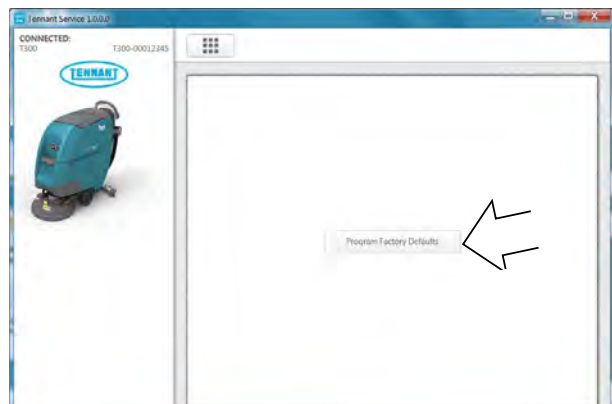


SERVICE

- Click on the I-Drive button.



- Click on the Program Factory Defaults button to program the I-Drive module.



- Cycle the key switch to save.

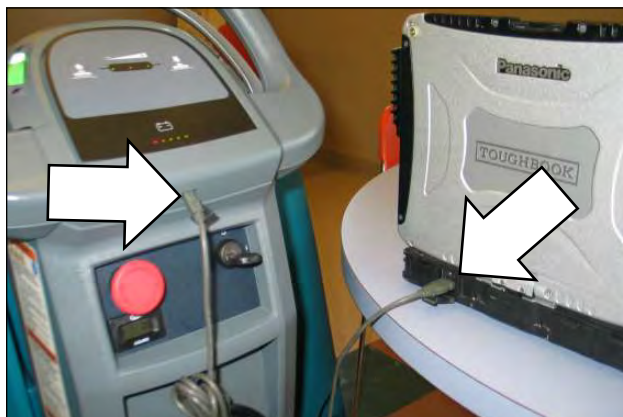
DISPLAYING FAULT CODES

SYSTEM REQUIREMENTS: Windows® 7 OS, Microsoft .NET 4.5 or later, USB to Mini-USB cable.

Authorized service providers can download the Service Diagnostics software from the My Tennant portal by visiting www.tennantco.com. Factory-Direct Tennant Service has this software installed on their *ServiceLink* devices.

A USB cable connects from the notebook to an external port on the control console. The SERVICE DIAGNOSTICS TOOL configures up to five control modules depending on optional trim packages. The interface module stores configuration data and communicates via RS232 serial communication with the i-Drive and through a CAN-Bus to all other modules.

- Connect a USB cable from a notebook computer to the machine and turn the key switch On.



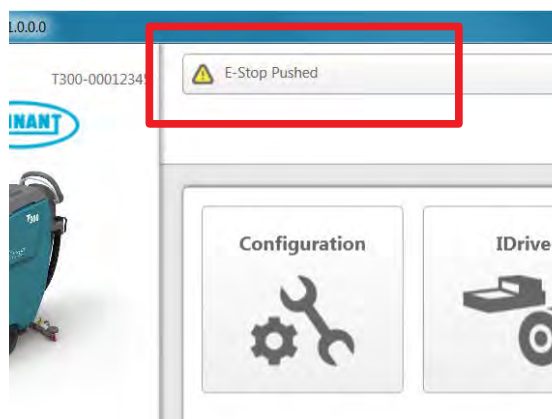
- Launch the software by double clicking the Service Diagnostics desktop shortcut or find the software in All Programs.

NOTE: Windows® may prompt a restart after installing the machine driver. Decline the restart, close Service Diagnostics and relaunch Service Diagnostics.



Service
Diagnostics

- Active faults scroll across the top of the home screen.



BATTERY CHARGER SETTINGS

The battery charger is set to charge the battery type supplied with your machine. If you choose to change to a different battery type or capacity, the charger's charging profile must be changed to prevent battery damage.

The machine's battery discharge indicator (BDI) must also be reprogrammed to match battery type to prevent battery damage and/or short run- time.

NOTE: For machines shipped without batteries, the battery discharge indicator and the on- board battery charger are set for GEL batteries as the default. If you choose to use a different battery type, the settings must be changed as described as below.

NOTE: For machines shipped without batteries and supplied with an Off- Board Charger, the off- board battery charger is set for wet lead- acid batteries from the factory. The machine's battery discharge indicator is set for GEL batteries as the default. The machine's battery discharge indicator must be reprogrammed to match charger settings (See OFF-BOARD BATTERY CHARGER below).

OFF-BOARD BATTERY CHARGER:

To change the off-board battery charger settings, See CHANGING OFF-BOARD BATTERY CHARGER SETTINGS.

To reprogram the machine's battery discharge indicator (BDI), service application software is required,

CHANGING OFF-BOARD BATTERY CHARGER SETTINGS

1. Disconnect charger from the machine and plug charger into power supply.



The middle LED will blink upon startup and the screen display "No Battery".



2. Press and hold the two outside arrows for 12 seconds or until the middle LED turns solid yellow.



SERVICE

3. Press the middle button to activate the battery type options (algorithms). The left LED will turn red.



6. Press the up arrow button until the "PROGRAMMING SAVE AND EXIT" screen is displayed.



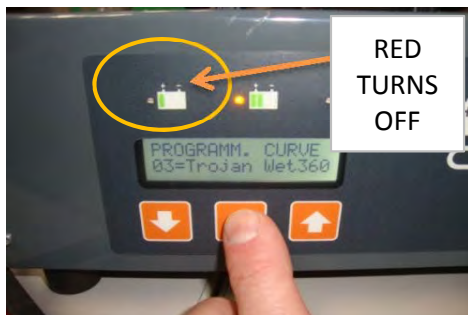
4. Press the up arrow button to scroll through the battery types (algorithms) until the desired battery type is located.



7. Press the middle button to save the new settings. The screen will display "PROGRAMMING PARAMETERS SAVED".



5. Press the middle button to select the battery type. The red LED light will turn off.



ON-BOARD BATTERY CHARGER

Pro/Membrane Models - Service application software required, contact service. As an alternative, the charger profile may be manually changed. See CHANGING ON-BOARD BATTERY CHARGER SETTINGS for Pro-Membrane model. The battery discharge indicator will automatically reprogram to match battery type when the battery charger profile is changed.

Pro-Panel Model - See CHANGING ON-BOARD BATTERY CHARGER SETTINGS for Pro- Panel model. The battery discharge indicator will automatically reprogram to match battery selection.

CHANGING ON-BOARD BATTERY CHARGER SETTINGS (Pro-Membrane model)

To manually change the on-board battery charger settings for a different battery type, carefully follow instructions as described below :

NOTE: The manual method is only an alternative if unable to change setting by use of the Service Application Software performed by Service.

1. Disconnect battery cables (Fig. 114).

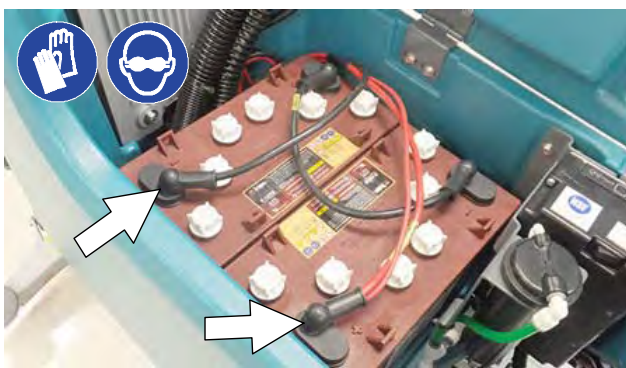


Fig. 114

2. Unwrap the battery charger power cord from the cord hooks.
3. Using a T25 star screwdriver, remove the two screws located at the bottom of the control console to access battery charger (Fig. 115).

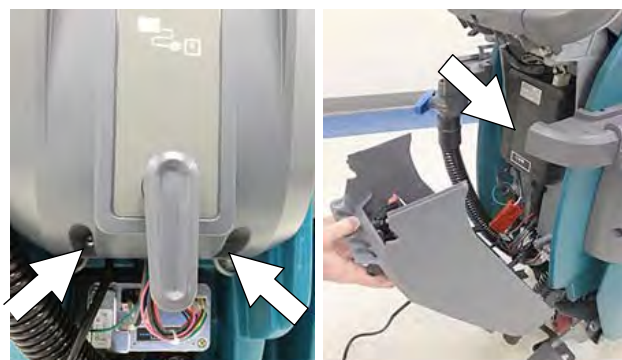


Fig. 115

4. Disconnect the battery cable, power cord and wire harness from charger. Using a T25 star screwdriver, remove the four screws that mount charger to machine (Fig. 116). Remove charger from machine.



Fig. 116

5. Remove the black cap from bottom side of charger to access the profile dial (Fig. 117)



Fig. 117

6. Using a small standard screwdriver, turn the dial to the appropriate battery type according to the following chart (Fig. 118).



Fig. 118

Dial Position	Battery Description Settings with AH Ranges
0	Factory setting* Programmed via CAN-Bus
1	Wet, Trojan 105- 155 AH
2	Wet, EnerSys/Tab 105- 155 AH
3	AGM, Discover 80- 150 AH
4	AGM, Fullriver 80- 150 AH
5	AGM, TPPL, EnerSys 20- 40 AH
6	Gel, Sonnenschein 80- 150 AH

**The CAN-BUS setting, dial position "0", is the software setting that is programmed to match battery type supplied with machine. When the dial is manually changed to a different setting, it should not be reset back to "0" otherwise battery damage may result. Service Application Software is required to reset dial back to "0". Contact Service.*

7. Replace the black cap on charger, reinstall battery charger and replace control console.
8. Reconnect the battery cable connection.
9. To set the BDI for the new battery type, plug the on- board battery charger cord into an electrical outlet. The machine's software will automatically reprogram the BDI to the new battery type.

CHANGING ON-BOARD BATTERY CHARGER SETTINGS (Pro-Panel model)

NOTE: To perform this procedure, machine must be in supervisor mode. See SUPERVISOR CONTROLS instructions at back of manual.

To change the on-board battery charger settings for a different battery type :

1. Turn the key to the on position.
2. Press the settings button located on the home screen (Fig. 119).

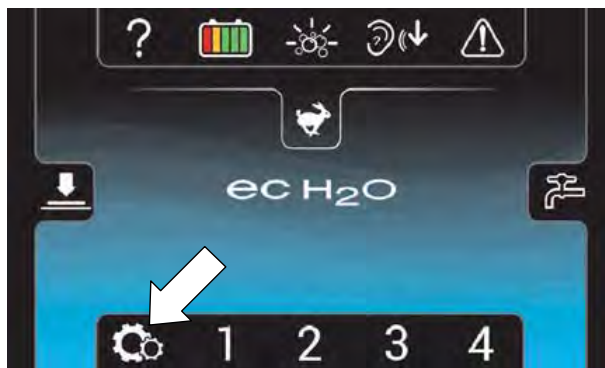


Fig. 119

3. Press the Setup button to access the Setup screen (Fig. 120).

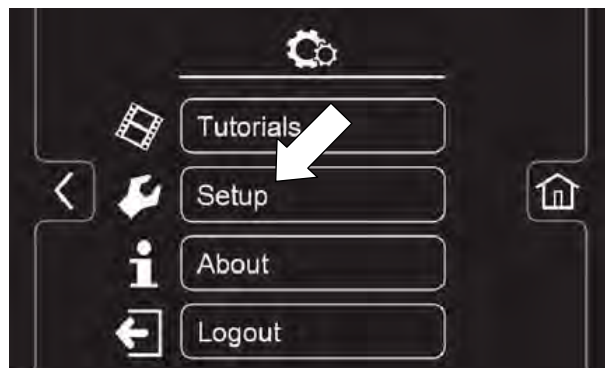


Fig. 120

- Press the Battery Type button to select the battery type installed in machine ().

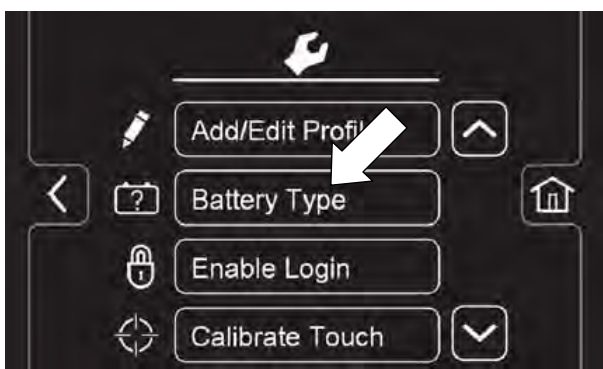
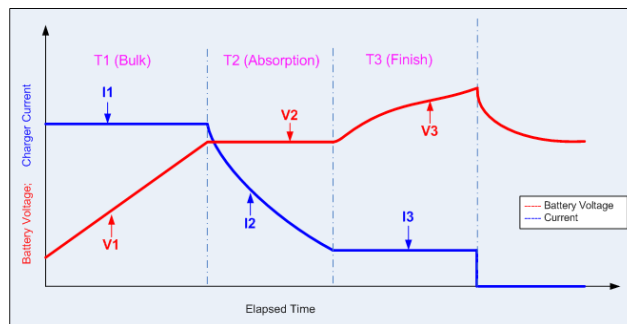


Fig. 121

BATTERY CHARGER OPERATION



Above is a graph representing the I-U-I (constant current-constant voltage-constant current) charging strategy used to charge batteries. For flooded (wet) lead-acid batteries, the finish voltage can rise up to approximately 34 Volts (24 Volt System). The finish phase of the charge cycle causes out gassing bubbles to mix up the electrolyte and prevent sulphation build-up in the battery.

NOTE: Flooded (wet) lead-acid batteries outgas during a normal charging cycle. Always charge batteries in a well-ventilated area.

The length of charge time for each phase and overall charge time varies based on the size of the battery, size of the charger, and other conditions of the battery such as discharge level, age of battery, temperature, etc.

Equalization Charge Cycle - The equalization charge cycle automatically occurs once every 30 complete charge cycles on (wet) lead-acid batteries only. Charge current increases to higher levels during the equalization charge to mix layers of electrolyte that form as a result of repeated charging/discharging cycles. Maintenance-free batteries can become damaged from an equalization charge, which is why it is important to make sure the Tennant-specified charger is programmed for the battery option used (see BATTERY CHARGER SETTINGS ON BOARD/OFF BOARD in the SERVICE section of this manual). Maintenance-free batteries, such as AGM and Gel, use slightly lower finish voltages (approximately 31 Volts) to keep the batteries from outgassing. Water can not be added to maintenance-free batteries, so these batteries must be replaced if they are repeatedly over charged or the cells are dry due to an incompatible charger or charger setting.

REMOVING SCRUB HEAD ASSEMBLY

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Drain recovery tank, turn off key, and disconnect batteries.
2. Remove debris tray (cylindrical only).



3. Remove scrub brushes and set aside.



4. Lower scrub head to floor.



5. Remove front shroud mounting hardware (2).



6. Pull forward to remove shroud. Set shroud aside.



7. Disconnect motor from wire harness connection.

8. Remove lift mechanism mounting bolts (2).

Note the orientation of the spacers and nylon washers for reassembly. Also, note the hole selection for the configured scrub head type.



9. Remove scrub head assembly.



INSTALLING SCRUB HEAD ASSEMBLY

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Installation is the reverse of removal.
2. Cylindrical Head Option Only: There are required brush pattern adjustments on the cylindrical scrub head (See CHECKING AND ADJUSTING CYLINDRICAL SCRUB BRUSH PATTERN in the SERVICE section of this manual).

CHECKING AND ADJUSTING CYLINDRICAL SCRUB BRUSH PATTERN

NOTE: This procedure must be completed using a new set of brushes. Following this procedure using worn brushes may result in uneven brush wear and shortened brush life.

1. Apply chalk to a flat, level surface.



SERVICE

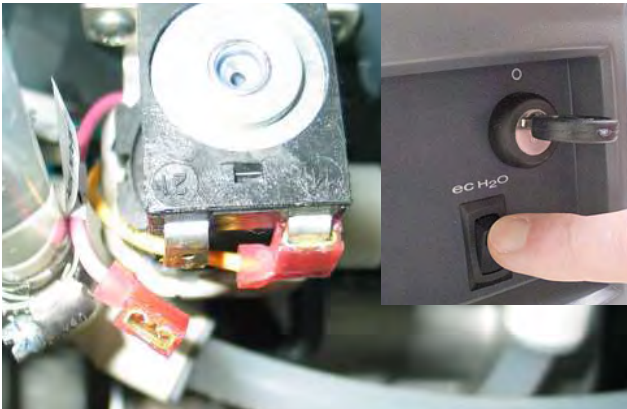
2. Disconnect the transaxle motor electrical connection.

NOTE: This must be done to keep the machine stationary during the brush pattern test.



3. Turn off ec-H₂O (if equipped) and disconnect the conventional water valve from the wire harness.

NOTE: This must be done in order to keep water from washing away the chalk that has been applied to the floor. Purge any residual water, at another location, by running the brushes for 30 seconds before proceeding to Step 4.



4. Move the scrubber so that the brushes are positioned over the chalk.



5. Set parking brake.
6. Lower the scrub head to the floor and activate scrub brushes for 20 seconds and then release the handle.



7. Release parking brake (if equipped) and pull the machine away from the pattern test site and inspect the brush pattern. The pattern shown below has a severe taper and requires adjustment to achieve two parallel rectangles.



8. To adjust the brush pattern taper, lower the scrub head to the floor.



9. Loosen (do not remove) the RH side linkage bolt.



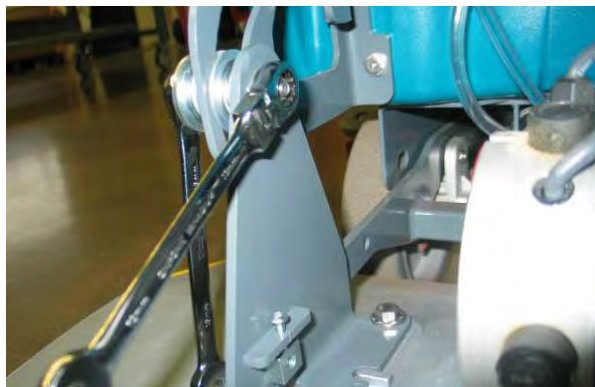
10. Turn the adjustment screw counter-clockwise to increase down pressure on the RH side or clockwise to decrease down pressure on the RH side of the scrub brushes.



11. Re-apply chalk and repeat steps 4-10 until the desired brush pattern is achieved and then retighten the linkage bolt with the **HEAD IN THE LOWERED POSITION**.



12. The taper adjustment is complete. If the pattern is uneven front-to-rear, the brush pattern can be further adjusted using the slotted top bolt. Loosen the top bolt just enough so the scrub head bracket moves freely and the scrub head settles in it's natural position on the level floor.



SERVICE

13. Tighten the top bolt and perform a final pattern check. Adjustment is complete.

REMOVING LOWER ORBITAL HEAD ISOLATORS

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Remove scrub head assembly. See REMOVING SCRUB HEAD ASSEMBLY in the SERVICE section of this manual.
2. Place the scrub head on a work bench and loosen the nyloc nuts for the (4) lower isolators.



3. Flip the head upside down and remove the pads.



4. Remove flat head screws securing the lower plate to the lower isolators.



5. Loosen the 4 mm set screw securing the concentric motor weight to the motor shaft.



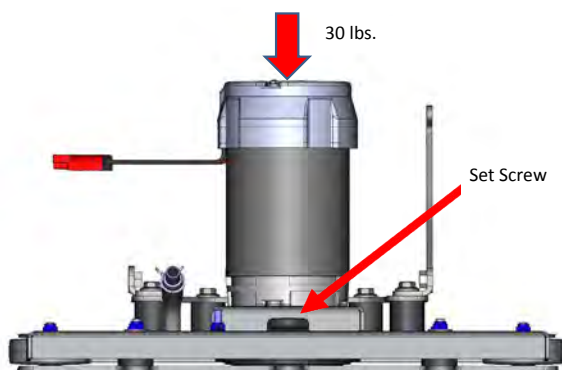
6. Remove the lower plate and the lower isolators (4).



INSTALLING LOWER ORBITAL HEAD ISOLATOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Installation is the reverse of removal.
2. During reassembly, place a 30 lb weight on the top of the motor while tightening the motor shaft set screw. This weight simulates the actual down force on the scrub head and sets the shaft preload. Torque the set screw to 15 ft-lbs (20 Nm).

**REMOVING TRANSAXLE ASSEMBLY (OPTION)**

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

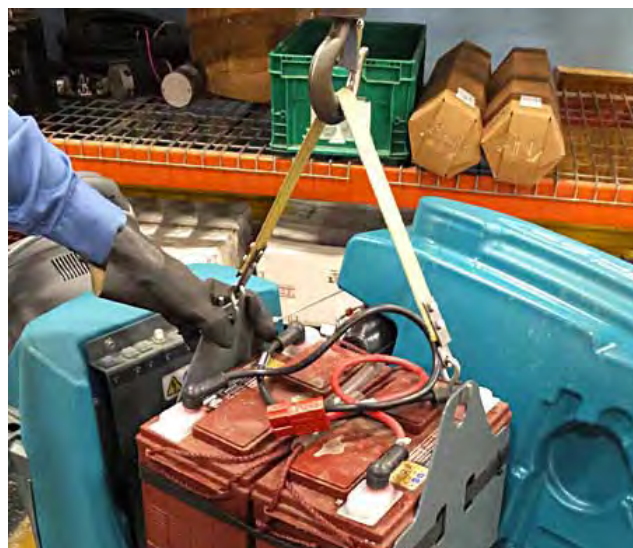
1. Drain solution and recovery tanks.



2. Disconnect batteries.

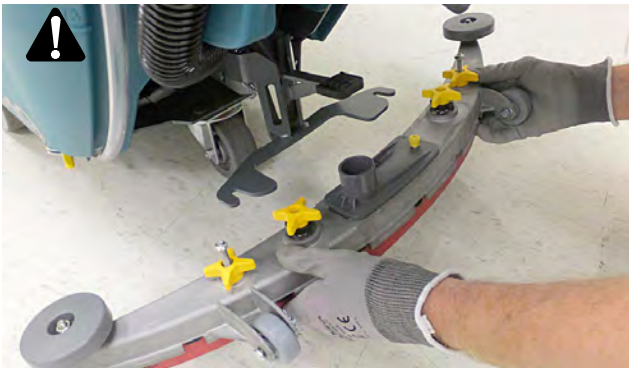


3. Remove batteries and set aside.



SERVICE

4. Remove rear squeegee assembly and set aside.



5. Carefully lower machine onto the left side using a protective blanket.



6. Remove wheel nuts (2). It will be necessary to raise the machine up and lower it to the right side to access the left side wheel.



7. Remove transaxle mounting hardware



INSTALLING TRANSAXLE ASSEMBLY (OPTION)

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Installation is the reverse of removal.

PTC (PUSH-TO-CONNECT) FITTINGS



MAKING A CONNECTION

1. Cut the tube square. The outer diameter of the tubing must be free from score marks, burrs or sharp edges.



2. Insert tube. The fitting will grip the hose before it seals. Be sure the tube is completely inserted into the fitting.



3. Push into the tube stop. The collet has stainless steel teeth which hold the tube firmly in position while the o-ring provides a permanent leak-proof seal.



4. Pull on the fitting to check that the connection is secure. Test the system for leaks prior to leaving the site. (Fig. 4)



SERVICE

DISCONNECTING

CAUTION: Contents may be under pressure. Relieve system pressure before disconnecting fittings.

1. Push in collet squarely against face of fitting to release the hose from the fitting. With the collet held in this position, the tube can be removed. The fitting can be re-used.



REMOVING VACUUM FAN

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Key Off and disconnect batteries.



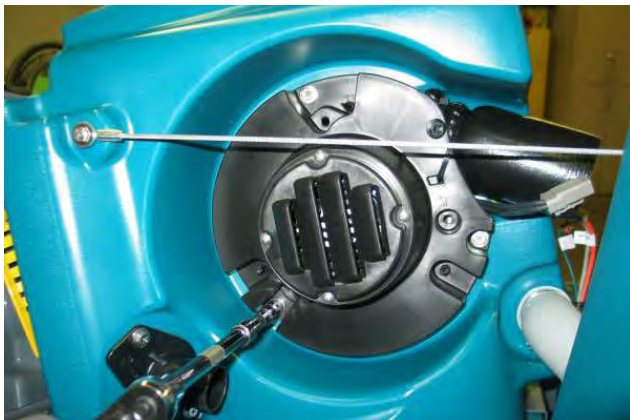
2. Remove rear squeegee hose from recovery tank.



3. Cut zip tie and disconnect vacuum fan from wire harness.



4. Remove vacuum fan mounting hardware (3).



5. Remove vacuum fan assembly.



INSTALLING VACUUM MOTOR

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Installation is the reverse of removal.

SERVICE

REMOVING CARBON BRUSHES

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Remove torx screws (2) securing vacuum fan cover assembly .



2. Loosen carbon brush mounting torx screws (4).



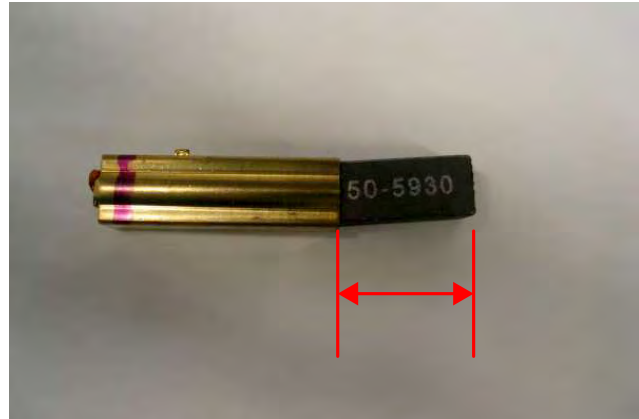
3. Lift up to release and remove carbon brushes (2).



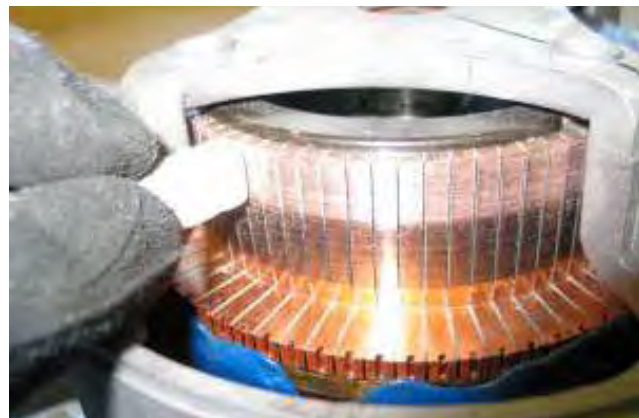
INSTALLING CARBON BRUSHES

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Inspect carbon brushes. Replace carbon brushes if they are stuck or are less than 10mm (0.375 in).



2. Clean the commutator using a stone and then use compressed air to clean any dust from inside the motor.



REMOVING WATER SOLENOID

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

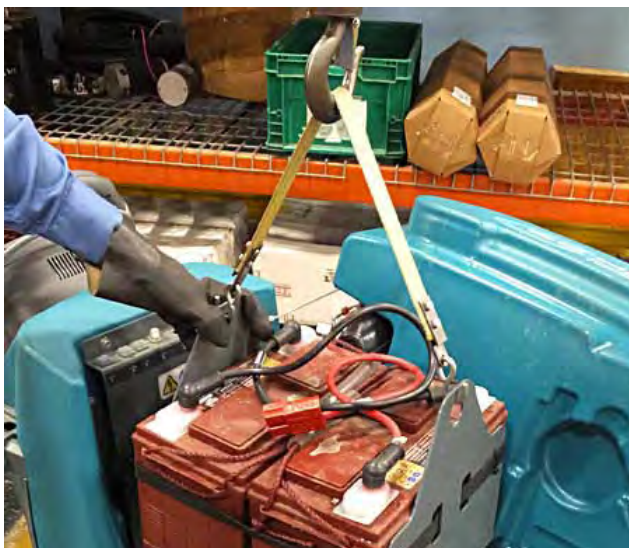
1. Drain solution and recovery tanks.



2. Disconnect batteries.



3. Remove batteries and set aside.



4. Remove rear squeegee assembly and set aside.



5. Carefully lower machine onto the left side using a protective blanket.



6. *Proceed to the next step for standard models.* Loosen knob set screws and remove knob. Set knob aside.



SERVICE

7. Disconnect electrical connections and remove T-25 Torx mounting screws (2). Set hardware aside.



8. Disconnect PTC (Push-To-Connect) connections (2) from solenoid. See *PTC (PUSH-TO-CONNECT) FITTINGS* in the *SERVICE* section of this manual.



INSTALLING WATER SOLENOID

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, remove key and disconnect batteries.

1. Installation is the reverse of removal.

ADJUSTING WATER SOLENOID

FOR SAFETY: Before leaving or servicing machine, stop on level surface, turn off machine, and remove key.

1. Loosen set screws (2) and remove knob from water solenoid. Set knob aside.

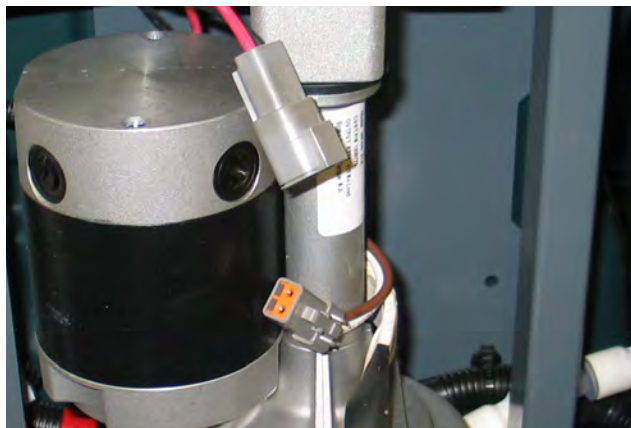


2. Disconnect scrub head side PTC (Push-To-Connect) fitting from water solenoid. See *PTC (PUSH-TO-CONNECT) FITTINGS* in the *SERVICE* section of this manual.

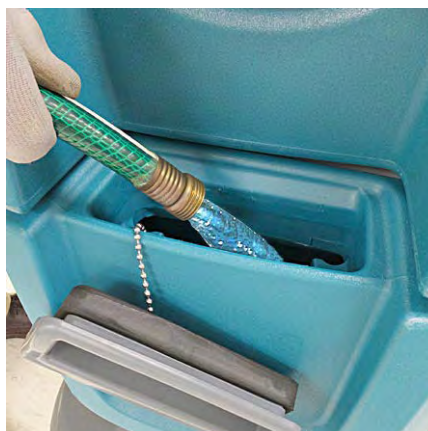


3. Disconnect transaxle motor (option) electrical connector.

NOTE: This is necessary to prevent movement while dispensing water during the adjustment process.



4. Add water to the solution tank.



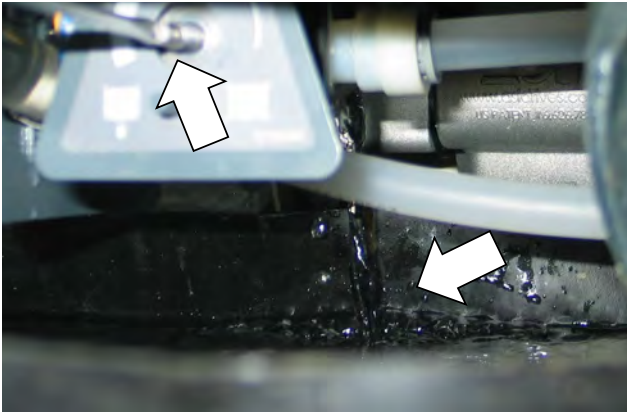
SERVICE

5. Place a shallow catch basin below the water solenoid, turn on floor scrubber and activate conventional solution flow by squeezing the handle assembly.

NOTE: Attaching a zip tie will assist in holding the handle while making adjustments to the water solenoid.



6. Turn the solenoid valve stem completely counter clockwise for maximum water flow.



7. Slowly turn the valve stem clockwise until water flow stops. *Stop immediately when water flow stops.* This is the no-flow or clockwise knob setting.

8. Reinstall the adjustment knob against the stop pin as shown below. Tighten set screws (2).

NOTE: Tighten one set screw and then rotate the knob to gain access to the other set screw.



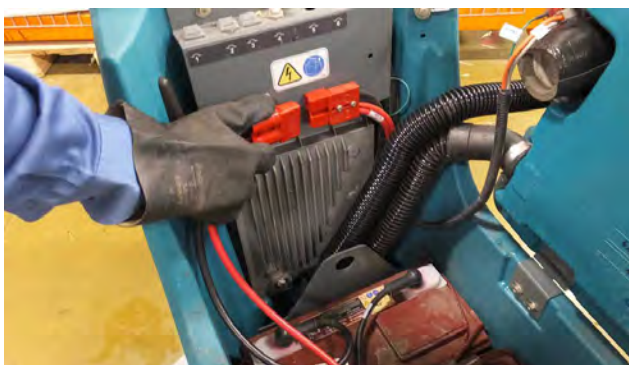
9. Reconnect PTC (Push-To-Connect) fitting to water solenoid valve, cut zip tie securing bail handle, and reconnect transaxle motor connection. Adjustment is complete.

CONTROLL MODULES**REMOVING MACHINE CONTROL MODULE (OPTION)**

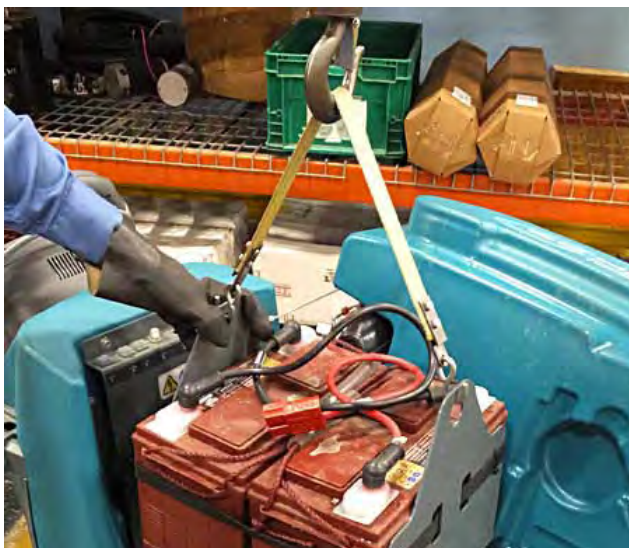
1. Drain solution and recovery tanks.



2. Disconnect batteries.



3. Remove batteries and set aside.



4. Cut zip ties securing hoses and wire harnesses to cover.



5. Remove the heat sink mounting bolts (2).



6. Carefully lower the heat sink and machine control module assembly and then disconnect all electrical connections.



SERVICE

7. Remove the heat sink and machine control module assembly from the scrubber.



INSTALLING CONTROL MODULE

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Attach a static wrist strap to the battery (-) terminal to prevent ESD damage to the logic board.



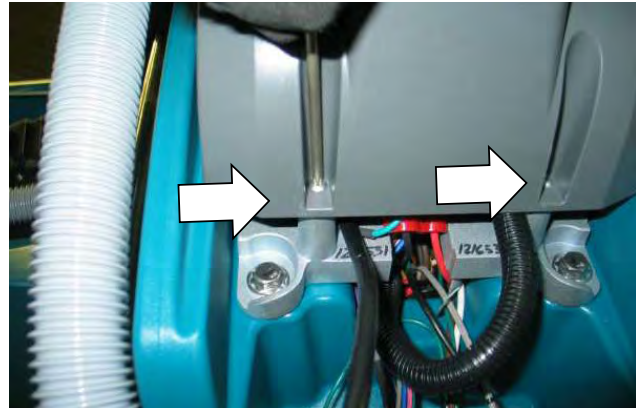
2. Installation is reverse of removal.

NOTE: The torque specification for control module electrical cables is 52 in-lbs (6 Nm).

REMOVING i-DRIVE MODULE (OPTION)

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

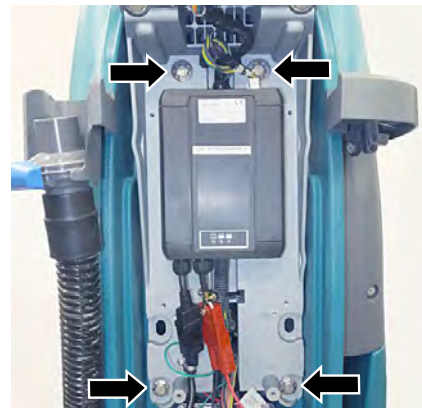
1. Key Off and batteries disconnected.
2. Remove T-25 torx mounting screws (2).



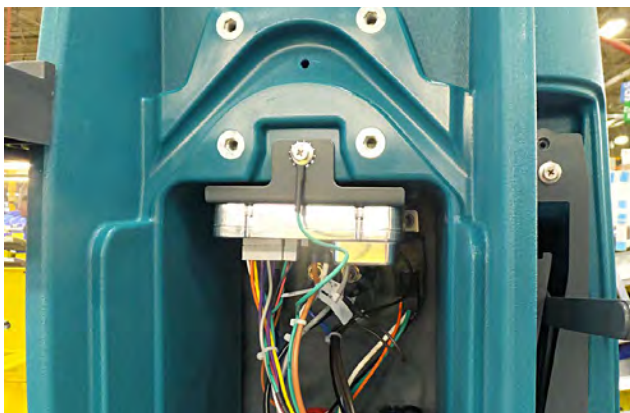
3. Carefully lower access cover.



4. Remove four (4) hex screws to remove the control consol plate.



5. Disconnect electrical connections and remove I-Drive mounting screws (2).



INSTALLING I-DRIVE MODULE (OPTION)

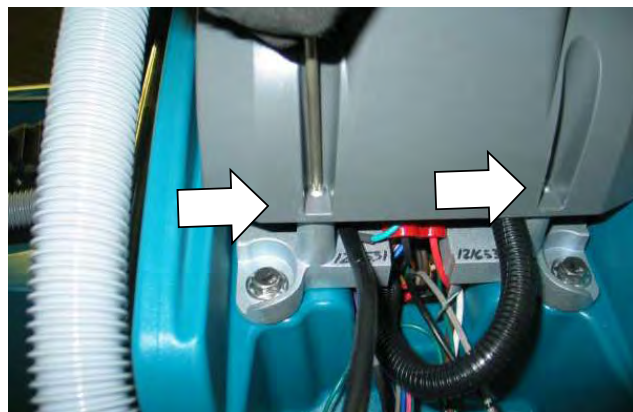
FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Installation is reverse of removal.
2. The new I-Drive module must be programmed to operate in the scrubber. See SERVICE DIAGNOSTICS TOOL in the SERVICE section of this manual.

REMOVING ONBOARD BATTERY CHARGER (OPTION)

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Key Off and batteries disconnected.
2. Remove T-25 torx mounting screws (2).



3. Carefully lower access cover.



4. Disconnect charger electrical connections.



SERVICE

5. Remove battery charger mounting torx hardware (4).



6. Remove battery charger.



INSTALLING ONBOARD BATTERY CHARGER

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Installation is reverse of removal.

NOTE: This battery charger can be programmed for multiple battery configurations. This configuration data is stored in the interface module and will automatically configure a replacement battery charger once installed and following a power-up cycle. Reprogramming is required if the interface module has been replaced, or if a different type of battery is used in the equipment (i.e. other than factory-installed equipment). (See SERVICE DIAGNOSTICS TOOL in the SERVICE section of this manual)

Models equipped with the PRO-Panel LCD Touch Panel can be configured through the touch panel. All other models must be configured using separate configuration software via a mini-USB programming port on the back of the operator's console. (See SERVICE DIAGNOSTICS TOOL in the SERVICE section of this manual.)

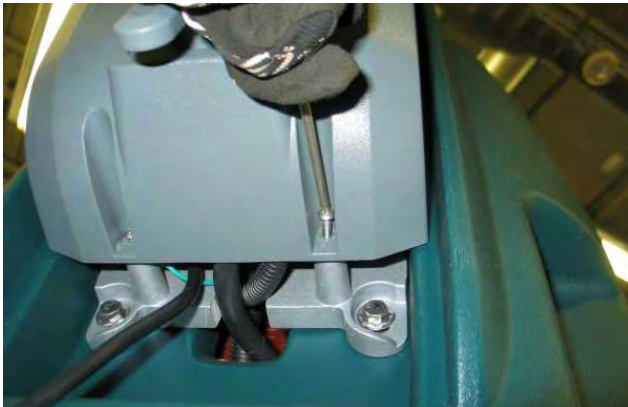
REMOVING INTERFACE MODULE

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Key Off and batteries disconnected.
2. Attach a static wrist strap to the battery (-) terminal to prevent ESD damage to the logic board.



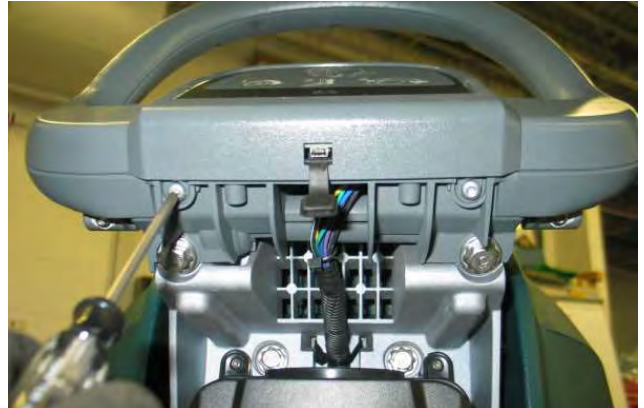
3. Remove T-25 torx mounting screws (2).



4. Carefully lower access cover.



5. Remove T-25 torx mounting screws (2).



6. Lift up on the bottom of the panel and slide downward to remove.



7. Disconnect electrical connections and remove interface module.

INSTALLING INTERFACE MODULE

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

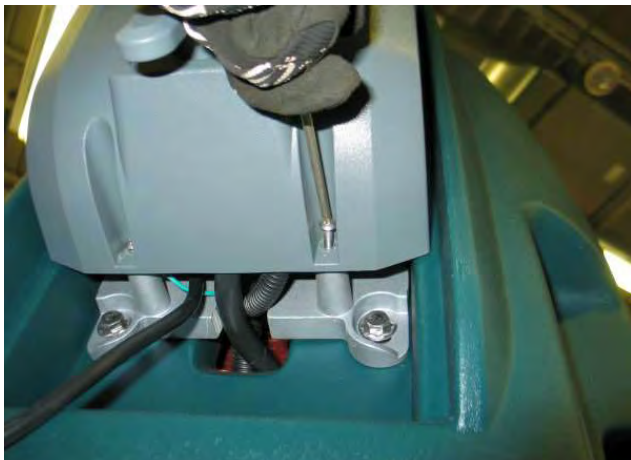
1. Installation is reverse of removal.
2. The new interface module must be programmed to operate in the Scrubber. See *SERVICE DIAGNOSTICS TOOL* in the *SERVICE* section of this manual.

SERVICE

REMOVING BAIL SWITCH, SPEED POTENTIOMETER, OR DIRECTIONAL SWITCH

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

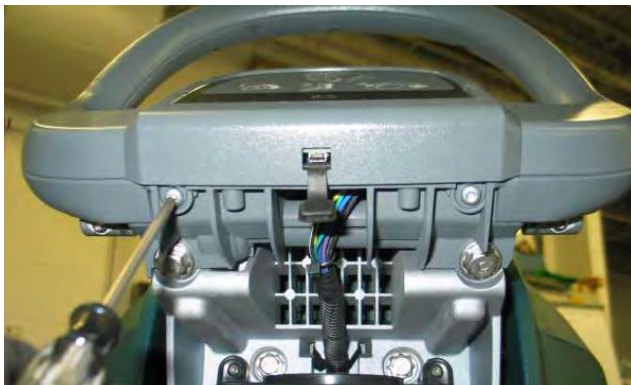
1. Key Off and batteries disconnected.
2. Remove rear access cover mounting screws (2).



3. Carefully lower access cover.



4. Remove T-25 torx mounting screws (2).



5. Carefully separate the touch panel from the console and disconnect all electrical connections. Set instrument panel aside.



6. Remove T-25 torx mounting screw (1).



7. Remove cover and set aside.



8. Remove operator console mounting bolts (2).



9. Lift up and forward to remove the operator console and place console on a work bench.



10. Remove plastic knobs and set aside. If replacing the potentiometer or directional switch, use a socket to remove the nut securing the potentiometer or the directional switch.



11. Remove bail screws (2) and set bail aside.



12. Remove screws (4) from front of operator's console.



13. Remove screws (9) from rear of operator's console and separate console assembly.



SERVICE

14. Release spring, rotate mechanism towards bottom of operator console, and slide assembly to the side to remove.



15. Remove bail switch.

INSTALLING BAIL SWITCH, SPEED POTENTIOMETER, OR DIRECTIONAL SWITCH

FOR SAFETY: When servicing machine, disconnect battery connections before working on machine.

1. Installation is reverse of removal.